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AN IMMENSE VACUUM PAN FOR SUGAR MAKING.

The repre-entation herewith shows probably the largest vacuum pan ever built, recently constructed by Robert Deeley & Co., at their works, foot of West 32d St., New York city, for the California Sugar Refinery, San Francisco, Cal., Claus Spreckles, president. The body of the pan is of iron, 1½ inches thick, there being four perpendicular sections, two dome-like sections at the top, and one bottom section, all accurately and carefully fitted and bolted together. The inside diameter is 17 feet, the height being 31 feet 7 inches, and the height to top of overflow 42 feet 6 inches. The capacity of this pan is about 1,000 barrels, or over 100 tons, of sugar at each "strike," the time required to make a "strike," or sufficiently exhaust the water from the juice before treatment by the centrifugal, being under ordinary conditions three hours.

The principle on which a vacuum pan is based is the fact that the boiling point of water, sirup, or any liquid, is in part dependent upon the pressure of the atmosphere, the temperature at which the liquid boils being higher or lower according as the atmospheric pressure is increased or diminished. In practice, with these pans, the liquor is boiled at a temperature of 110° to 120° F., so there is no danger of burning the sugar, the inversion of sugar is reduced to a minimum, and the rapidity of the operation is greatly increased. A pan of this size must necessarily be of great strength, in order to resist the atmospheric pressure, which increases according as the vacuum is more perfect.

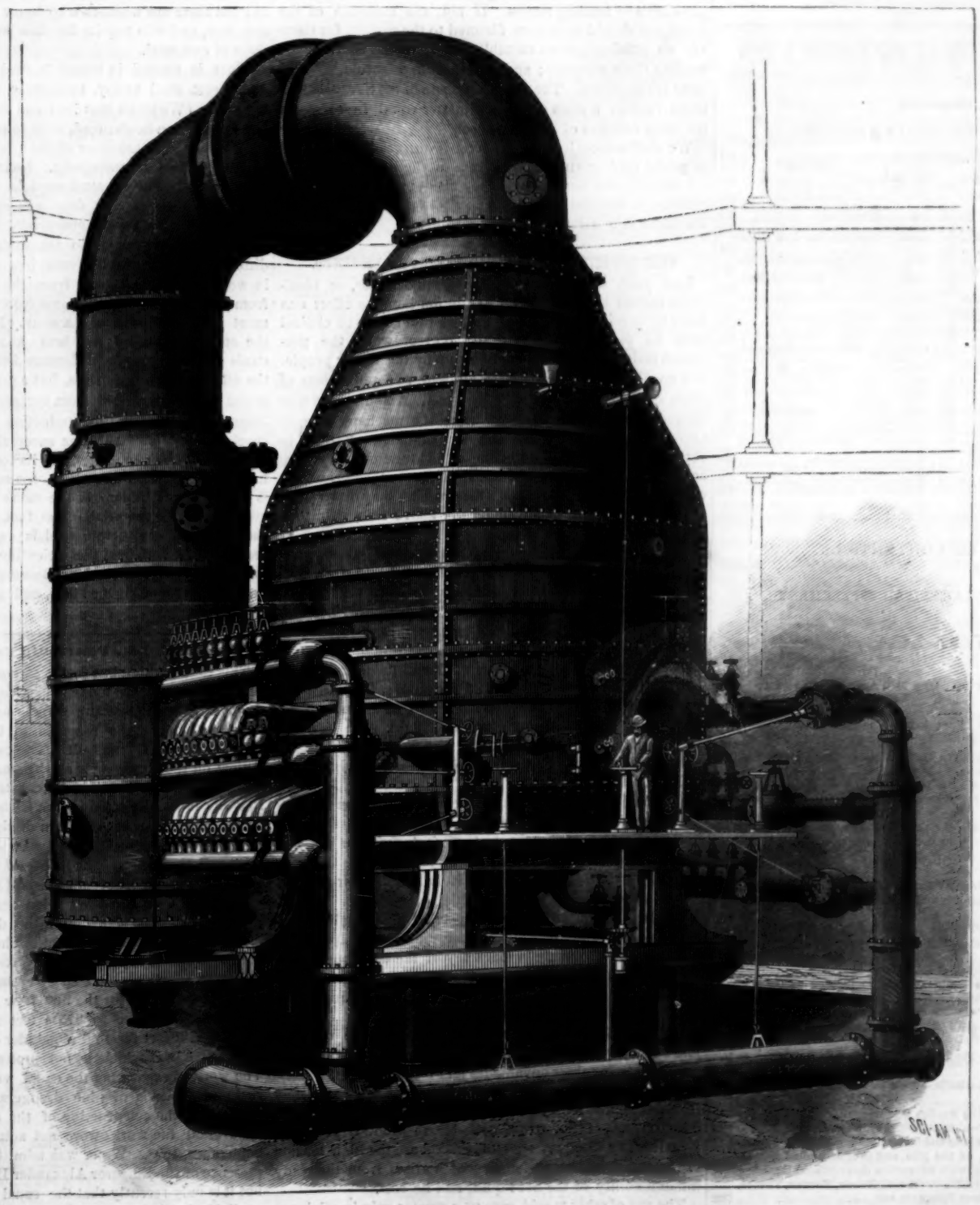
The arrangements for heating will be readily understood by reference to the illustration, the copper coils for this purpose presenting a surface of over 3,000 square feet. There are eight of these separate coils, five being of 4 inch diameter and three of 5 inch diameter, affording 69 inlets and outlets, and connected with eight steam trunks, two of 8 inch and six of 12 inch diameter, the steam being supplied by a 30 inch main. Every facility is given for easy working, all the main valve stems being carried to convenient positions on the working platform, from which also the "strike," or discharge valve at the bottom of the pan, is operated. This valve is 20 inch diameter.

The pan is charged with the liquor through two 6 inch valves, controlled on the working platform, the atmospheric pressure readily forcing the liquor in. The cane juice with which the pan is charged usually gauges 25° to 30° Baume, or about 10 pounds to the gallon, and when discharged it is about the consistency of thick mortar. It is intended, in operation, that this pan will be filled with liquor only to a depth of 18 feet, leaving 8 feet vapor space above within the pan itself, besides the room allowed in the great pipe leading from the top. There is a spray catcher or intercepter in the dome of the pan, and the vapor pipe leading up from its top is 6 feet in diameter. Situated in this vapor pipe, between pan and condenser, as shown on illustration, is a portion enlarged to 10 feet diameter forming a trap to catch any overflow, which can be returned to pan or tanks, as desired, and thence the 6 foot vapor pipes continue to condenser, which is 8 feet diameter and 28 feet high. The condenser has two 8 inch perforated injection pipes and four scattering plates. The pumps which make and maintain the vacuum are connected with the condenser, forming what is termed a "dry" vacuum.

The pan has two of what are styled lock proof-sticks, for removing and testing from time to time a small quantity of the sirup, but these proof-sticks are in reality tubes with nicely fitted valves and a piston for removing the sirup without destroying the vacuum. There are also eight eye-glasses arranged in different positions to enable the operator to keep a constant watch on the work going on inside the pan. A barometer and thermometer are also connected with the interior of the pan, by which the extent of the vacuum and the temperature of the contents are indicated at a glance. Formerly vacuum pans were built almost exclusively of copper, but of late years cast iron has been the choice, only the heating coils being of copper, the coils being so fixed as to prevent their vibrating during the boiling, and allowing for expansion and contraction without strain.

Besides the amount of fuel saved and the economy of conducting the sugar manufacture with a pan of such device as this, where the work can all be so easily overlooked and the process minutely regulated, probably the greatest advantage of all lies in the largely increased proportion of sugar thus gained, and the comparatively small quantity of molasses which each "strike" affords. By such improved pans the yield of sugar amounts to six or eight hogsheads to one of molasses, while by less improved means only two or three hogsheads of sugar are obtained to one of molasses.

The whole work was completed in four months at the Deeley Iron Works, the order having been received July 10, while the pan was being taken down for shipment the second week in November.



AN IMMENSE VACUUM PAN FOR SUGAR MAKING.

The Journey of a Million.

Statistics as carefully studied by Dr. Farr tell us that of a million children ushered into life nearly a hundred and fifty thousand pass away by the end of the first year. Twelve months later fifty three thousand more will have followed. At the end of the third year the number living will be diminished by twenty-eight thousand more. Each year of the decade following will make its inroads upon the ranks, but less serious in amount, till the thirteenth year will call for [illegible] than four thousand. Those remaining will fall out at a round and threescore strength end of the fifth year, but there will be four place, in the interval either period about been hundred thousand have succumbed to the hardships of early way. At the end of sixty years three hundred and seventy thousand gray haired veterans would still be keeping step with the duties of the passing days. Eighty years would see thirty-seven thousand remaining, with strength impaired and steps growing feeble. At the end of ninety-five years but two hundred and twenty-three would linger in the darkening path, and these would be rapidly thinned till in the one hundred and eighth year the last survivor of the million would disappear, and join the ranks of his predecessors in the great host of the majority.

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NEW YORK, SATURDAY, DECEMBER 6, 1884.

Contents.

(Illustrated articles are marked with an asterisk.)

Animals as barometers..... 357
Ballast, scientific..... 358
Bessemer steel works in the United States..... 354
Blast, carbon, for extinguishing fires*..... 359
Business and personal..... 362
Canal, St. Petersburg..... 352
Claw bar, Harwick's*..... 354
Cupola, Dr. Otto Gmelin's*..... 360
Dispatch in the machine shop... 356
Distances, estimat. methods of.. 353
Dye, yellow..... 355
Electricity from machine belts... 357
Expansion, value of the coefficient of..... 354
Feed mechanism for roller mills, Rusch's*..... 354
Fire escape, Windmoyer's*..... 356
Fluid in vapor engines, efficiency of..... 353
Forces, natural, utilization of in electric lighting..... 353
Fountain, Colladon's*..... 356
Furniture, old and new..... 360
Gas, natural, vs. coal..... 361
Gumbo..... 356
Idonium..... 351
Inventions, agricultural..... 362
Inventions, engineering..... 362
Inventions, index of..... 367
Inventions, miscellaneous..... 363
Inventors, American, chance for 360
Iron and steel, burning of..... 356
Japan, trade with our..... 353
Journey of a million, the..... 351
Light, firefly..... 361
Locomotive, smoke burning..... 357
Mine, iron, a Mexican..... 360
New books and publications..... 362
Notes and queries..... 367
Oysters..... 357
Ozone, liquefaction and color of..... 358
Pan, vacuum, for sugar making, an immense*..... 351
Paper, letter, a sheet of may move a ton a mile..... 360
Patent Office business, fiscal year 1883-84..... 361
Piano, Mason & Hamlin's*..... 355
Pianos, upright, imp. in*..... 355
Plow, improved, Stevenson's*... 354
Principles, first, for young mechanics..... 357
Relic, an interesting..... 356
Rope serving machine*..... 354
Sabine, Robert Henry..... 356
Slide, beautiful, a..... 360
Specially for our readers..... 352
Steel uniformity..... 352
To news agents..... 353
Tramway, elevated, without rails a new*..... 358
Women, centenarian..... 359
Wood, petrified..... 354
Wood, preservation..... 361
Working to advantage..... 353

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 466,

For the Week ending December 6, 1884.

Price 10 cents. For sale by all newsdealers

PAGE

I. ENGINEERING AND MECHANICS.—A New Method of Constructing Horizontal Tubular Boilers..... 7438
Portable Bridges.—With an engraving of the whole structure, and 15 figures of details of Cottrau's portable bridge over the River Sarno, at Castellamare..... 7439
Combined Locomotive and Car.—Lehigh Valley Railroad..... 7440
The Creators of the Age of Steel.—Bessemer, Siemens, Whitworth, and Gilchrist..... 7445

II. TECHNOLOGY.—Test for the Viscosity of Oils.—By W. P. MASON 7440
The Stanhope Water Softener and Purifier.—With 3 figures..... 7443

III. ELECTRICITY, ETC.—Telephoning without Wires.—Abstract of an address by Professor E. J. HOUSTON before the Franklin Institute..... 7443
Devices for Making Electric Connections.—16 figures..... 7444

IV. ARCHITECTURE.—The Wall.—A lecture delivered by Prof. T. ROGER SMITH to the architectural students at University College.—Foundations.—Materials, ancient and modern.—Egyptian, Grecian, and Roman walls.—Arcades.—Ornamentation of walls.... 7442

V. NATURAL HISTORY.—The Luminosity of Luciola Italica..... 7446

VI. BOTANY.—Livistona Australis.—With engraving..... 7446

VII. MISCELLANEOUS.—The English Nile Expedition.—The Nassif-Kheir passing up the Bab-e-Kebir.—Full page of engravings 7432
Cairo to Khartoum.—A long and interesting article, with a general view of Cairo, a map of the Nile, and over fifty small engravings of remarkable places, with interesting descriptions; including the Temple of Luxor, Philæ, Denderah, Esneh, Karnak, Thebes, the Great Sphinx, the Great Pyramids, etc..... 7432
The Navigation of the Nile..... 7437
English Boats for the Nile Expedition.—With engraving..... 7438

SPECIALLY FOR OUR READERS.

The annual election of periodicals may be said to be going on now. This is the time when people make choice of the papers and magazines they are to enjoy during the next twelve months. New volumes begin with the coming year, and subscriptions are soon to be entered up. All readers of the SCIENTIFIC AMERICAN will, as a matter of course, renew. The cost—$3.20 a year—is less than a penny a day. We should be glad if each of our friends would send in one additional penny per diem, and thus add the SUPPLEMENT to their regular subscriptions. For $7 a year—less than two cents a day—both papers are supplied. These are the cheapest as well as the best scientific publications in the world. We issue a double number this week to present the catalogue of valuable papers published in the SUPPLEMENT. The reader will therein find the key to vast wealth of information, and will conclude, we trust, that duty to himself, to the needs of his calling, to the wants of his mind, requires him to give the additional penny and enroll his name as a subscriber.

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We have one additional request to ask of our friends, namely, that they will inquire if the SCIENTIFIC AMERICAN and SUPPLEMENT are regularly taken and filed in the town libraries and reading rooms. If not, the attention of the managers should be at once directed to the matter, for there are no publications so valuable and necessary as these for reading room purposes; and in respect to scientific subjects none are so cheap. The yearly numbers of the SUPPLEMENT alone furnish a mass of reading matter equal in extent to ten large volumes of 350 pages each.

We shall esteem it a special favor if our readers will send us postal cards giving the addresses of the libraries or reading rooms in the towns where they reside; we shall then take pleasure in forwarding specimens of our papers, from which librarians may determine their usefulness.

THE EFFICIENCY OF FLUID IN VAPOR ENGINES.

Last year, when the so-called thermic motor, or bisulphide carbon engine, was on exhibition here, an effort was made by several engineers to subject the motor to critical tests, to determine how nearly correct were the pretended claims of great economy set up by the motor people. But no disinterested tests were allowed, and purchasers of stock are said to have been badly stuck. Among those who desired to test the "thermic" were the mechanical engineers, Messrs. H. L. Gantt and D. H. Maury. Failing to obtain permission to test the engine in question, they were compelled to confine themselves to a purely theoretical discussion of the subject, and the results they have now given in a very able paper, under the above title, published in *Van Nostrand's Magazine*.

The authors say: "Rankine, Clausius, and others have proved that the amount of heat transformed into work does not depend upon the fluid which is the conveyer of that heat, but simply upon the limits of temperature between which the fluid is worked. It follows that, theoretically, all fluids are equally efficient in transforming heat into work; it does not follow, however, that all fluids are equally valuable as the working fluid of an engine, for there are other considerations besides efficiency to be taken into account in making choice of a working fluid. We have set ourselves the task of choosing the best working fluid from the following liquids: water, alcohol, ether, bisulphide of carbon, and chloroform."

The final conclusions reached are substantially as follows: "*If we limit maximum pressure to that employed in the steam engine, steam is the most efficient fluid we can use.* The relative size of cylinder necessary to produce the same power is smaller for steam than it is for the non-aqueous vapors when all have the same initial pressures.

The higher initial pressure, involving higher initial temperature, and consequently greater range of temperature, causes such an increase of efficiency of the non-aqueous vapors as to put them all above that of water, and to cause some doubt as to which would be the best working fluid, judged thermodynamically only.

As the most convenient method of deciding the question just raised, we may compare each of the vapors with that of water, showing their advantages and disadvantages.

The vapor of alcohol gives us 1·4 per cent more efficiency than steam, and requires a cylinder whose volume is only 0·853 of that of the steam cylinder to produce the same power. The disadvantages of alcohol are the high tension of the vapor, the great danger which arises from the ready inflammability of the hot liquid, and its cost.

The use of ether would give us a greater gain in efficiency (2·11 per cent), and would require a still smaller cylinder (0·535 of that of steam), but it is open to the same objections as alcohol, and in a more marked degree.

The vapor of bisulphide of carbon gives a gain in efficiency of 3·71 per cent, and demands a cylinder 0·550 of that of steam. It, however, is not only open to all the objections that have been stated against alcohol and ether, but it has two which are peculiar to itself, viz., its intensely disagreeable odor and its power of rapidly corroding iron which comes alternately into contact with it and with the air.

The vapor of chloroform, which gives a gain of 3 per cent efficiency, and requires a cylinder 0·761, the volume of that of steam, is not open to the objection of inflammability, but it has so high a cost that it is probably impossible that it can ever be used economically in competition with steam.

All the apparent advantages of the non-aqueous vapors may be gained in the steam engine by an increase of initial pressure; and, as the tendency of modern practice is in that direction, it seems certain that *none of the non-aqueous vapors will ever successfully compete with steam.*"

STEEL UNIFORMITY.

The users of steel for manufacturing purposes, and probably the producers of steel, would welcome any information that would insure uniformity in the product. It appears to be almost a waste of investigating endeavor to argue on the relative merits of steel produced from the iron and that cemented from the bar. The true test of their relative merits is that of use in practice. Yet there seems to be an almost insane desire to turn all our iron into steel, and to produce steel as directly from the ore as pig iron is produced. An enthusiast recently called attention to some lathe and planing tools, cast from iron melted in the cupola in the regular way, and then submitted to a cementing process of brief duration, claiming them to be true cast steel, or its equivalent. And there are others who assume that all the work of cementation and the after processes may be dispensed with, and good tool steel result.

This nonsense will be taken up and repeated by mechanics who may be like the Athenians described in Acts xvii., 21; but there are workers who know steel from carbonized cast iron, and who require for their work all the proper qualities of cast steel.

What is needed in regard to steel information is how to make cast steel to day, to-morrow, and so on indefinitely, the same. We know that iron can be refined, and that its components can be changed, so as to improve its quality, and so that it can assume some of the qualities of cast steel, and be called steel commercially. But what is required is an equable quality of the steel used for tools.

This equable quality does not exist among the steels made by the best known manufacturers; they may claim it, but the facts of practice do not sustain the claim. All the differences in working different lots from the same makers, in working different bars from the same lot, in working from the same bar, do not come from the difference in treatment and manipulation. A chart of tests comprehending the steels of five of the best known manufacturers of steels show not only a difference between the products of the different establishments, but a great lack of uniformity in the specimens tested from the same maker. An establishment that makes the production of small steel tools a specialty, and is probably as successful as any other in this country, or other countries, has its tools returned for failure in exactly opposite directions—too soft, too brittle. What is to be done? There is the same treatment of, commercially, the same material. The fact is that uniformity in the character of crucible steel is an attainment yet to be reached and it is time that scientific and practical men devoted their attention to this attainment, instead of arguing on the identity of purified iron, called "Bessemer steel," and cast steel *per se*.

St. Petersburg Canal.

This canal, which has just been completed, is intended to enable ships of large tonnage coming from abroad to reach the port of St. Petersburg direct, and to take in cargoes there, without having recourse to the hitherto inevitable transshipment at Cronstadt. The canal extends from Goutouiew on the Neva as far as the small roadstead of Cronstadt. A branch has been excavated along the Pontilow Railway in the direction of the Catherinhof, an arm of the Neva. The Neva has also been dredged to meet the requirements of the Russian navy, between the canal and the source of the Catherinhof. The length of the canal is 17¾ miles, and the length of its branches is 2½ miles.

The bed of the Neva has been dredged for a distance of 5,333⅓ feet. The canal and the dredged portion of the Neva have a depth of 24¼ feet. The depth of the branch varies between 17½ feet and 23½ feet. On the portion of the canal which is protected by embankments, the width of the base is 213 feet for the first four versts from the Neva. This width is carried to 275½ feet for the next 3¼ miles, and to 355½ feet for the remainder of the canal, which is the portion of it which is not protected by embankments. The work of excavating the canal was almost entirely carried on by means of nine dredgers. The imperial order prescribing the construction of the canal was signed June 1, 1874, but the works were not actually commenced until September, 1878. Water was admitted into the canal in the presence of the Emperor Alexander III., November 12, 1883; but it is only recently that the canal has been finally made available for the passage of vessels. The works of the canal cost altogether 1,642,464*l*.

METHODS OF ESTIMATING DISTANCES.

There appeared recently, in *La Nature*, a simple method of estimating distances, with illustrations and formulæ, for use of the military in the field. The method was as follows: Small silhouettes of standing and kneeling soldiers are cut out from stiff card-board, and painted black, or the actual uniforms may be shown in color; the standing soldiers to be about one inch in height, and the kneeling ones two-thirds of an inch. These figures and the average height of of soldiers (say 65 inches) have a constant value, and in the formula given stand h and H respectively. A distance, for illustration, is now paced off, by the person holding the silhouettes, of say 3 meters, or about 10 feet, from the person who is to make the observation, and the silhouettes are adjusted to just cover the soldiers seen in the distance. This base line, l, of ten feet, being given, the ratio will stand: $x = l\frac{H}{h}$, or required distance, and for this value of l should be 650 feet. By proportion it is shown thus:

$$h \quad l \quad H$$
$$1 \text{ inch} : 10 \text{ feet} :: 65 \text{ inch} : x = 650 \text{ feet}.$$

It will be seen by this operation that l must vary with x.

There is another method of estimating distances which the writer of this adopted several years ago merely for pastime. As some surprisingly accurate measurements have been made by this method, and as some of the ideas appear to have a bearing on the question of a possible absolute ratio of measurement, pertaining to, and variable with, each individual, it is given herewith, for the purpose of inquiry and thought. The experiments at the time were based upon this idea, that the true focal distance of every eye will furnish a true working ratio for all distances, provided practical application of the same can be realized. In this method, H, the diameter or height of a distant object, and l, the focal distance of 10 inches, will each be constant; but h will have to vary with x, or, $x = H\frac{h}{l}$ provided the normal focal distance l of the observer is 10 inches. To make the matter still clearer to the mind, let us consider that for every unit of distance an object decreases in width $\frac{1}{10}$, or for 10 units a decrease of 1 is found. By this, it can be readily seen that a focal ratio is obtained for a measurement in units; whether in inches, feet, or miles; as the diameter of the distant object shall determine.

In this simple way an approximate distance of the moon or sun, as well as terrestrial objects, may be worked out in a few minutes.

My method of operation was as follows: Having, after repeated trials, fixed upon 10 inches as the true focal distance in my case, a simple sight piece and measuring apparatus was constructed, consisting of a ten inch wooden rod or eye rest, to the end of which was attached a movable slide or gauge, exposing an opening in an upright metal diaphragm, which was firmly attached to the end of the rod; by moving the gauge in and out, the diameter of a distant object could be easily sighted, and the open space could be then measured by a micrometer. Several measurements having been obtained, the mean is taken to be the true one.

Further, to illustrate: Suppose the same distance is taken as in the measurement given with the silhouettes, taking the formula $x = H\frac{h}{l}$, and substituting the figures, we have $x = 5{\cdot}5 \text{ feet } \frac{0846}{10} = 650$ feet. That is, the focal measurement of a soldier 5·5 feet in height is found to be 0·0846 of an inch, and one-tenth of this gives the ratio for every foot of distance.

A good way in estimating short distances is to select a window of a dwelling. The average width of windows is about 3 feet; at the distance of half a mile one should just cover 0·011 of an inch in the micrometer.

Any object may be selected, the average width or length of which is known, such as barns, houses, haystacks, stone walls, sections in rail fences, or a common barway, telegraph poles, etc.

If a focal distance of less or more than 10 inches is used in sighting and measuring an object, it should take the place of 10 in the formula given above; the approximate distance obtained in either case should be the same. Suppose some pleasant night we wish to find the distance of the moon from the earth. For this purpose a glass micrometer ruled with dark lines should be used, ruled either to the $\frac{1}{24}$ or the $\frac{1}{100}$ of an inch; after several trials, an average diameter should be obtained of about 0·09 of an inch; this of course will vary somewhat with the moon's distance. Now the approximate distance will be:

$$x = 2{,}162 \text{ (moon's diam.)} \div 0{\cdot}09 = 240{,}000 \text{ miles}.$$

Let us next smoke our micometer, and during the day time take a look at the sun.

Suppose our measurement stands 0·093 of an inch, the distance obtained in the same way as above would be:

$$x = 850{,}000 \text{ (sun's diam.)} \div 0{\cdot}093 = 92{,}391{,}000 \text{ miles}.$$

There is considerable misapprehension on the part of most people concerning the great difference between the apparent visual diameter of the moon and the sun and that to be obtained by micrometric measurement. But few people will believe that the actual measurement of either is less than the tenth of an inch, until a fair trial has been made. In a similar way, with the aid of a telescope, and the diameters as given by the astronomers, we may partially verify the approximate distances of the planets. There are many ways in which this little formula will amuse as well as instruct.

G. R. C.

Our Trade with Japan.

Middle aged readers can readily recall the time when the empire of Japan and the heart of Africa were equally unknown to the world, and the memory of Perry's notable unsealing of the ports and commerce of Japan must be fresh in their minds. It was a triumph of American diplomacy, and to-day there comes to these shores $14,000,000 worth of goods annually, while the amount and value of these imports augment rapidly. A feature of the Japanese trade seems to be that those engaged therein almost invariably make money. It is a trade which calls for special fitness, and once established seems better than the average silver mine.

Of Japanese imports, during the season ending December 31, 1883, New York took nearly $6,000,000 in value; Chicago, $2,500,000; San Francisco, a half million; and Canada say three and a half millions. Their value goes to show that in exchange for the half million dollars' worth of refined petroleum sent to Japan last season, Uncle Sam gets an assortment of invaluable articles. First in value and importance is crude camphor, a substance that more closely resembles a cheap grade of white sugar than anything else. It was imported to the value of half a million dollars last season—33 241 piculs.

Japanese vegetable wax is another important product of the awakened island. It is a rival of paraffine wax in many ways, and is consumed in great quantities by New England cartridge makers, and by manufacturers of celluloid. Of this substance, over 2,600 piculs were imported last season, worth nearly $300,000. The cuttlefish bone, without which the life of the imprisoned canary would be stale, flat, and unprofitable, is still another product of Japanese origin. Over 1,600 piculs were imported last season, worth $246,000. This article showed an increase in the amount imported of 100 per cent over the previous year's trade. Then comes Japanese fish oil, a competitor of our menhaden oil. The wonderful abundance of fish in Japanese waters, and the fact that labor can be procured for a few cents daily, enable exporters to send this oil 10,000 miles, and still compete with that expressed from fish that swarm along the Atlantic coast. Of this article, over 100,000 piculs were imported, worth $246,000. Isinglass, due to the abundance of fish already referred to, was imported from Japan last season to the extent of nearly 9,000 piculs, worth $264,500.

The metal antimony, of prime necessity in medicine, is yet another valuable product of Japan, and the last season brought out nearly 30,000 piculs, worth $138,000. The type founder is a large consumer of this peculiar metal also, for it possesses the singular property of retaining its volume when cooling after melting, while other metals shrink. This endows metal alloyed with antimony with the attribute of retaining a clear cut impression of the mould, so requisite in type making. Among the articles which are found among the Japanese merchants' samples is a silvery powder. This powder glistens from the surface of modern wall paper, imparting a beautiful appearance, and it serves to enhance the charming snow scenes depicted on Prang's Christmas cards. This substance is Japanese mica, ground to powder, and when used as described gives the article it is spread upon all the sparkling beauty worn by the surface of snow under the moon's rays.

The list of Japanese goods includes a long array of articles, some of them as unique as the country from whence they come and the people who make them, but the *Independent Record* asserts that above are the leading articles of interest to our trades.

Working to Advantage.

It is amusing to notice how easily a workman who understands some of the mechanical principles that govern the behavior of matter, will handle a difficult undertaking with no other strength than his own, assisted with a little forethought and head work. A large water wheel shaft lying in a wheel pit, and loaded down with pulleys and a large gear wheel, was brought out by a single workman and placed across the beams of iron, while the rest of the machinery was in motion, and sent off to the shop without any one ever noticing the difficult undertaking. When this same piece of machinery was first set in place, a dozen hands took part in the undertaking and stirred up the whole concern for material to work with, and arranged a slide with pulley blocks strong enough to launch a vessel on dry land, pulled and hauled everything to pieces, cut and injured everything that came within their reach, to say nothing about the other little incidents that would last a village gossip for a week, such as a few broken bones, a lame foot, with the doctor's bill thrown in.

But the shaft found its place, however; and when the time arrived for a change in its position, as well as additional fits to be made, a chain made fast to the beam overhead and fast beneath the shaft through the open spaces in the pulleys to another at the other end, enabled the workman to roll the shaft up out of the pit by turning the gear wheel, while he himself backed up the ladder till the load was placed carefully on the planks that had been left, with a little forethought, where he could slip them in place with his feet. Such an undertaking is certainly a risky one, and we would not advise such a proceeding, especially when the machinery on all sides was in motion. Instances of this kind have been noticed where it was almost impossible to understand how such difficult undertakings could have been accomplished with the material they had to work with, while others, of a very simple nature, have brought mishaps and failures, with nearly everything any one could ask for to work with.

A large gear wheel, several feet across, was to be placed over the end of an upright shaft, and nearly a whole day had been expended in making the preparations for moving the wheel on rollers and elevating with jack screws, when two strong hands took hold of the wheel and placed it in its position on the shaft while the others were taking their noon hour, by first balancing the wheel on one edge of the hub and rolling it on this portion of the wheel up the incline of a stout beam, without meddling with the blocks and roller ways that had been all the forenoon in preparation.

A heavy column was once elevated into its upright position by a small lad, with no other help than his own strength and a little calculation, after those who had been employed to raise the structure had given it up in despair, by taking advantage of the rocking motion allowed in the position the column was to occupy, which allowed this youthful specimen of grit to set up each shore, on either side, by moving one at a time as the column was crowded on to the other, till at last it stood upright upon its base.

Hundreds of instances of this kind can be related where the success was owing to the careful manner in which the whole performance had been laid out at the commencement, and followed with care and forethought that protected the whole proceeding from accidents and mishaps, while others have come to an untimely end in their endeavors, through negligence and carelessness on the part of the work hands, who had no definite idea as to what they were driving at.—*Boston Journal of Commerce.*

The Utilization of Natural Forces in Electric Lighting.

In the discussion of the paper on "Domestic Electric Lighting," read by Mr. W. H. Preece at the recent meeting of the British Association in Montreal, Sir W. Thomson referred to the facilities afforded by the proximity of the Lachine Rapids, situated five miles distant, for lighting the city by electricity generated by the aid of natural forces. An experiment in this direction is now being made at Bellegarde, in the department of the Saone-et-Loire. Some two and a half years ago M. Dumont, a manufacturer of the town, was granted permission to utilize the waters of the Valserine (a stream in the vicinity), with the view of obtaining a supply of motive power; and the necessary works were commenced. They were finished last year, and are described in *La Nature*.

The course of the stream lies between high rocks, and the water is dammed up by means of a wall about 40 feet wide at its base, and having three sluices for regulating the direction and volume of the current. The water has a fall of 165 feet, and flows out at the rate of 1,100 gallons per second; being equivalent to a hydraulic power of 2,000 horses. This force it is intended eventually to divide between three turbines, one of which (of 600 horse power) has already been fitted up, and is employed in driving the machinery used in the lighting of the town by electricity. The current is generated by two small Gramme machines; and the lighting is done by Edison incandescent lamps placed in the ordinary street lanterns. No accumulators are employed, so that the current passes to the main conductor (which is carried round the town on poles) directly from the generators; its strength being regulated, not by them, but by the turbine which drives them. The lighting is said to be brilliant; but there are several inconveniences attending it. In the first place, the lamps (even those of the private consumers) are either all alight or all out at the same time. Then there have been some rather untimely extinctions; while occasional variations in the luminous intensity of the lamps have testified to certain irregularities in connection with the machinery. Leaving these out of consideration, M. Dumont may be said to have succeeded fairly well in lighting a town by electricity generated by the aid of natural forces. He hopes, however, to go beyond this, and afford, by means of electric cables, a supply of power to those works whose proprietors may be willing to take it of him.

Idunium.

"Idunium" is the name proposed by Professor Webshy for the metal just discovered by him as one of the components of native vanadate of lead. The mineral is rather a scarce one of a yellow color, and contains several other metals, of which zinc, iron, and arsenic are among the most prominent. Idunium resembles vanadine in several respects, both physically and chemically, while the only oxide hitherto examined forms stable salts with alkaline bases, and thus would appear to possess distinctly acid properties. It will probably be known by and by as "idunic acid," and as its general characteristics and reactions correspond to those of vanadic acid, its formula will probably be Id_2O_5.

To News Agents.

If for any reason your news company fails or declines to supply back numbers of the SUPPLEMENT, send the order direct to this office, and we will have it promptly filled. The SUPPLEMENT is never "out of print." We supply all the back numbers. The news companies have no valid excuse for not furnishing any copy of the SCIENTIFIC AMERICAN SUPPLEMENT that may be called for.

The Value of the Coefficient of Expansion.

An illustration of the way in which a coefficient like 0·000006, that of the expansion of steel, may become a big thing with a few degrees of rise of temperature and long lengths has been seen, says the *Engineer*, on the new Midland line between Irchester and Sharnbrook, recently opened for goods traffic. The rails were laid during winter time, and insufficient room was left for expansion, consequently the summer heat expanded the rails to such an extent that the road burst out of line. Traffic had to be at once stopped and the permanent way altered and properly spaced. Accidents from the "spreading" of rails are far more frequent that is supposed on roads in this country. Your compiler long ago showed the vital necessity of regulating the space allowed for expansion at the ends of rails by constant reference to the height of the thermometer on the spot and during the whole process of laying the rails.

CLAW BAR.

The square face-plate of hardened steel has its corners bent upward, rounded, and recessed to form claws for receiving the body and head of a spike; the under side is slightly convexed to fit snugly upon the curved upper side of the bar, to which it is united by means of a pivot bolt and nut. The bar is formed substantially the same as an ordinary claw bar for drawing railroad spikes, with a recess in the end for the body of the spike. Through the bar, directly in the rear of the pivot bolt, is a hole, through which is passed a bolt whose head rests in one of the claw recesses of the face-plate; the under side of the bar is rabbeted to form a bearing for the nut. If the claws which are in use should break, by removing the rear bolt another pair of jaws may be brought over the recess in the bar. The recesses in the face plate may be of different widths to adapt the bar to spikes of different sizes.

It is evident that this claw bar will wear four times as long as the ordinary bar, and by renewing the worn-out plate

HARDWICK'S CLAW BAR.

can be quickly refitted for use; and as the plate can be more nicely finished and better tempered than the end of the common bar, still greater durability is insured.

This invention has been patented by Mr. James L. Hardwick, lock box 569, Cedar Rapids, Iowa.

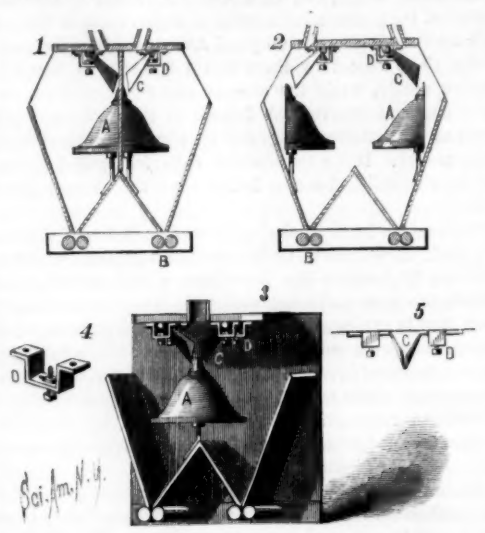
Bessemer Steel Works in the United States.

There are 21 Bessemer steel works in the United States and 1 in process of building. These 21 works contain 46 converters, and 3 converters are building. The total annual capacity of the works completed is 2,490,000 net tons of ingots. The plant building is that of the Benwood Iron Works, at Benwood, W. Va. The States that have Bessemer works are: Massachusetts, one, with two 4 ton converters; New York, one, with two 7 ton converters; Pennsylvania, nine, with twenty-two converters, and one building, ranging in size from 2 ton to 10 ton; West Virginia, one, with two 5 ton converters, and one building, which will have two 4 ton converters; Ohio, three, with five converters, ranging in size from 4 ton to 10 ton; Illinois, four, with nine converters, ranging from 6 ton to 10 ton; Missouri, one, with two 7 ton converters; Colorado, one, with two 5 ton converters.

The first Bessemer plant in the United States was erected in Troy, N. Y., and made its first blow February 15, 1865; the second was erected at Steelton, Pa., and made its first blow June, 1867; the third was erected in Cleveland, Ohio, which made its first blow October 15, 1868. The largest Bessemer plant in the United States is that at Steelton, Pa., which contains two 7 ton and three 8 ton converters. The next largest are the Edgar Thomson, at Pittsburg, and the North Chicago, at Chicago, which have three 10 ton converters. The domestic works are now more than able to supply all domestic demands for Bessemer steel, and one of them recently received a 10,000 ton order from Canada for rails.

FEED MECHANISM FOR ROLLER MILLS.

The engravings illustrate a feeding device for roller mills, patented by Mr. Julius Busch, of Marine, Ill., which will deliver the material evenly to the rolls. The material is directed to the grinding rolls, B, by cant boards. Adjustably supported from the cant boards or the sides of the hopper by a threaded rod having an adjusting nut is a half-bell shaped



BUSCH'S FEED MECHANISM FOR ROLLER MILLS.

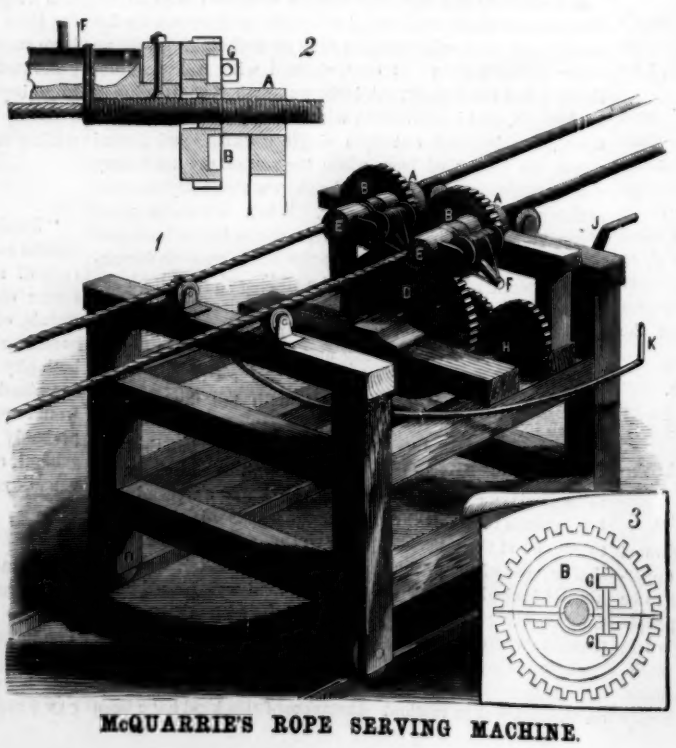
distributer, A, as shown in Figs. 1 and 2; or as shown in Fig. 3, two of these distributers may be combined. Fixed to a rod supported within slotted brackets, D, is an inclined spout, C, the lower end of which is directly over, or nearly over, the apex of the distributer upon which the material is delivered. The rod is prevented from turning by the action of screws and nuts resting upon the bottom of the brackets, the inclination of the spout, to deliver the material higher or lower, having been previously affected. The slots in the brackets permit of the lateral adjustment of the rod to admit of the lower end of the spout being located farther from or nearer to the distributer, according as the end of the spout is raised or lowered. A smaller distributer may be placed upon the apex of the large one when fine, soft material is being fed to the rolls; two of these may be united for use with the distributer, A, Fig. 3. Material is fed to the hopper through delivery spouts. For coarse, sharp middlings the distributer, A, only will be needed. The middlings from the spout, C, striking upon the curved face of the distributer, will be spread in a thin, even stream, which, falling upon the side of the hopper or the cant board, will be delivered in an even stream to the rolls. For fine, soft middlings the smaller distributer may be placed upon the apex of the other, and the spout so adjusted as to deliver near the upper apex.

ROPE SERVING MACHINE.

The frames are supported upon wheels adapted to run on suitable rails for moving the machine along the ropes that are arranged in guides, A, on the top beam. Mounted on each guide is a toothed wheel, B, which is geared with a master wheel, D, operated from a crank, J. Each of the wheels, B, carries a boss extending a short distance from the side parallel with the rope to which the tension device, E—called by the inventor a "mallet"—is pivoted to bear on the rope. This device (Fig. 2 is a section of one of the guides and tension devices, and Fig. 3 shows a tension device and reel carrier divided in two parts and bolted together to facilitate the rigging of the machine to the ropes) consists of a cylindrical block of wood of considerably larger diameter than the rope, and having a groove along the side next to the rope, in which the rope is made to bear by the yarn which, in passing from the spools, F, is carried around the mallet and the rope a couple of turns, first passing through an eye in an arm projecting from the mallet. The spools are pivoted in arms projecting from the mallet and from the boss, so that the spools and mallets are carried around the ropes.

The guides are made in two parts, the upper of which may be taken off to facilitate the adjusting of the ropes, and the wheels, B, are also divided for the same purpose. To enable the attendant to turn the winding wheels while walking by the side of the machine, and also to enable the crank to be applied so as not to be interfered with by the ropes, the train of wheels, H, is geared with a wheel on the shaft of the master wheel, D, the crank being applied to the shaft, H. The machine will naturally feed along by the pressure of the coils laid on the ropes against the yarn being laid on; but it will need to be pushed to some extent by the attendant, and the push rod, K, is so arranged that the force is applied at the middle of the front end; the rod extends back, so that the operator can push the machine with the left hand while turning the crank with the right.

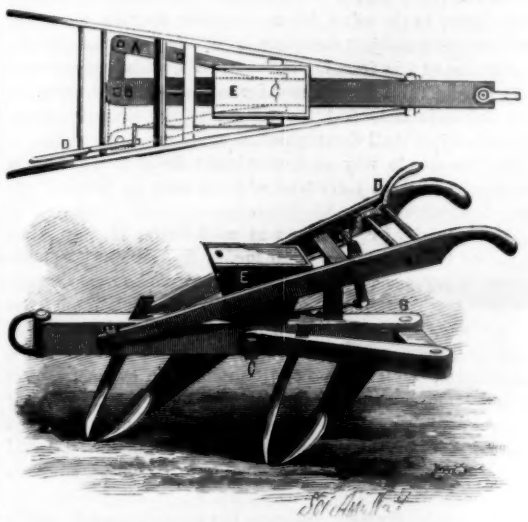
Further particulars regarding this machine may be obtained by addressing the inventor, Mr. Archibald McQuarrie, Post Office, Buffalo, N. Y.



McQUARRIE'S ROPE SERVING MACHINE.

AN IMPROVED PLOW.

The accompanying engraving shows a plow which, although suitable for use on level ground and as a cultivator after planting, is more particularly intended to be used as a sidehill corn planter. The inner plow beam carries, near its forward end, a share secured to a standard, and a colter. The corn hopper, E, is provided with a slide operated from the handle, D, by means of intermediate connecting rods and levers. A supplementary plow beam, A, carries a share, standard, and colter similar to those on the main beam.



STEVENSON'S IMPROVED PLOW.

This plow beam is arranged to lie to one side of the rear portion of the main beam, as shown by the full lines in both cuts, or to either side of the main beam, as shown by the full and dotted lines in the plan view, to do the hill-side or special work required of the plow and planter. To accomplish this purpose the beam is fitted to turn horizontally from the rear end of the main beam to opposite sides of the latter. The ends of both beams are slotted and connected by a link pivoted at each end. When the beam, A, is swung to a position in line with the main beam, its share and colter face in a reverse direction to the forward share and colter; but when it is swung to either side, the shares and colters face in the same direction with the rear ones to one side of those forward. The movable beam is held in place by a tooth on its free end, engaging with a latch, C, on either side of the main beam. A very important advantage of this combined plow and planter is that the share on the beam, A, may always be located on the upper side of the hill when at work, to operate as a covering shovel.

This invention has been patented by Mr. James N. Stevenson, of Salvisa, Ky.

Petrified Wood.

The petrified wood which is so abundant in Arizona, Wyoming, and Rocky Mountain regions, is utilized in San Francisco, where there is now a factory for cutting and polishing these petrifactions into mantelpieces, tiles, tablets, and other architectural parts for which marble or slate is commonly used. Petrified wood is said to be susceptible of a finer polish than marble or even onyx, the latter of which it is driving from the market. The raw material employed comes mostly from the forests of petrified wood along the line of the Atlantic and Pacific Railway. Geologists will regret the destruction of such interesting primeval remains, and some steps ought to be taken to preserve certain tracts in their original state.

IMPROVEMENTS IN UPRIGHT PIANOS.

Improvements in the construction of upright pianos have been invented and introduced by the Mason & Hamlin Co., of Boston, New York, and Chicago, which add materially to the value of these instruments, rendering them capable of tones of extraordinary purity and beauty, and much increasing their durability; overcoming in large degree the tendency to fall from the pitch and get out of tune, which has been the most serious practical difficulty in the pianoforte.

The principal of these improvements, which we shall illustrate and describe, consists in a different mode of fastening the strings. Instead of holding them by iron pins driven into wood, as has heretofore been done, the Mason & Hamlin Co., by an ingenious invention, fasten each string directly to the iron plate itself, so holding it exactly, securely, and permanently. From the instability and changeable character of wood it has been impossible to do this when the latter material was employed. Yet upon such exact holding evidently depends very largely the quality of tone of the piano, and in still greater degree its capacity to stand at correct pitch.

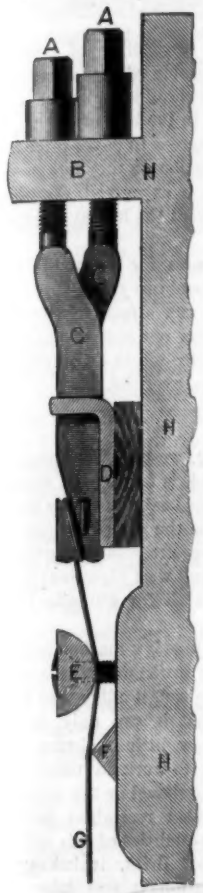


Fig. 2.

THE OLD METHOD OF STRINGING PIANOS

is shown in Fig. 4. X is a part of the iron plate, which, when securely bolted to the heavy wood support at its back, *y*, forms the frame on which the strings are stretched. These strings are held by the iron wrest pins, Z Z Z, which are simply driven into holes prepared for them in the wood. Sometimes the iron plate is extended to cover the whole of the wooden frame, and in that case has holes through which the wrest pins are driven into the wood. In tuning the instruments the iron pins are turned back or forward, winding or unwinding, and so tightening or loosening the strings. Disadvantages of this old method evidently are:

1. It is difficult to tune the instrument exactly. A very slight turning of the pin back or forward changes the tension of the string sufficiently to alter the pitch materially. The tuner has, therefore, to turn the pin back and forward repeatedly until he hits, partly by chance, the exact tension required. Sometimes he is compelled to effect the slight difference needed by bending the pin, or forcing it toward or away from the string, so as to tighten or loosen it very slightly. Now, the hold of the pin upon the wood, by which the string is held, is mainly through friction, and by the process of tuning this friction is lessened, just as the hold of a round nail in wood is diminished by turning it round and bending to and fro. Thus every time a piano constructed on this old system is tuned, it is more or less injured. It is not a rare case that the injury is so great as to render the piano practically useless in a few years, because it becomes practically impossible to tune it with any reasonable approach to accuracy.

2. A yet more important disadvantage of this old method of holding the strings arises from the changeable nature of the wood, which swells and shrinks with atmospheric changes. It must be remembered that a very slight change in the tension of the string will affect the pitch of its tone. Hence least changes in the wood, which would ordinarily be immaterial, are of consequence here. The great liability of pianos, as they have been made, to get out of tune, arises mainly from this cause, and every player knows that its constant getting out of tune is the great difficulty in the use of the piano. The fact that the whole iron plate of the instrument has been securely bolted to a heavy wooden frame increases this difficulty, because in swelling and shrinking the wood springs the plate more or less.

3. The heavy wood support of unvibrating wood at the back of the iron plate is a detriment to the instrument, preventing the freest, fullest vibration of its strings, and tending to make its tones dull and mixed with mere noise.

THE IMPROVED METHOD OF STRINGING

invented by the Mason & Hamlin Co., and introduced in their pianos, is shown in accompanying cuts. Fig. 1 shows a piano with the front of the case removed. H is the iron plate or frame, made strong enough to bear the full strain of

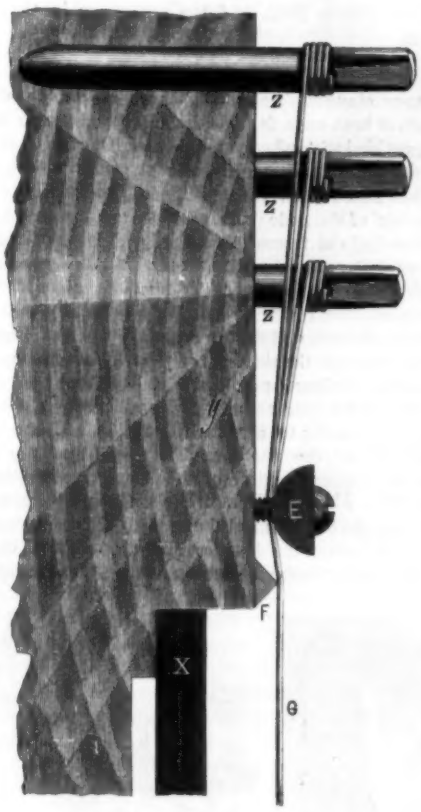


Fig. 4.

the strings without any wood support at its back, which is so left open for more perfect and free vibration of strings and resonance of tones as reflected from the sound board, which extends behind the strings to the top of the frame. B B is a metal flange cast in and forming a part of the iron plate or frame itself. Through this flange pass the screws, A, to the lower ends of which the strings are attached.

Fig. 2 shows on a larger scale a side view of the stringing device, by which the string is fastened to the iron frame and its tension is regulated.

Fig. 3 gives a front view of the same, showing the upper parts of six strings (producing two tones).

A is the screw threaded nut, by the turning of which the strings are drawn up or let down. B is a flange, cast in and a part of the iron plate itself. C is the screw headed blade to which the strings are attached. D is the guide which holds the screw headed blade in position during the process of tuning. E is the usual pressure bar which holds the string firmly to the upper bridge. F is the upper bridge, a triangular piece of metal, on which the strings rest, and are properly spaced. G is the string itself. H H is a part of the iron plate or frame on which the strings are stretched.

It will be seen that by this method of stringing, the employment of wood, either for the fastening of the strings or the support of the iron frame at its back, is entirely dispensed with, and so the disadvantages of its use are avoided; metal with its greater strength and comparatively changeless character being substituted. Principal advantages claimed for this method of stringing are:

1. Peculiarly bright and pure musical tones are produced. The strings, being exactly and permanently held at each end, are not liable to the imperfect or false vibrations which are inevitable in the old way of stringing. Then the absence of the wood at the back of the metal frame is a material advantage, giving great freedom to the tones produced by the vibration of strings as perfectly reflected from the sounding board.

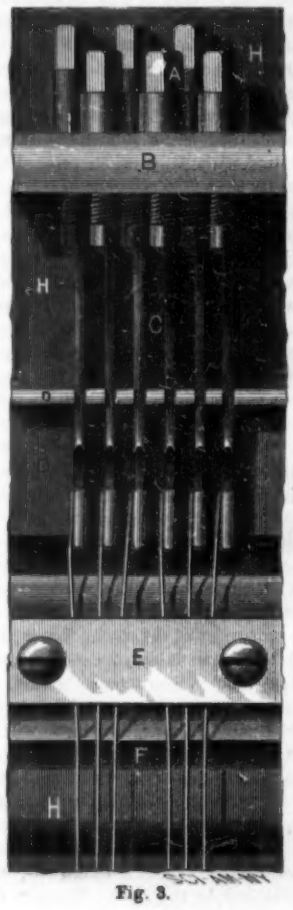


Fig. 3.

2. Permanence in good qualities of tone is secured. The strings remain as properly stretched on the iron frame, and are not subject to the unfavorable changes coming from fastenings in changeable wood.

3. The piano is easily and exactly tuned, and has extraordinary capacity to remain in tune. Under the old system considerable force was required to turn the wrest pin, and one revolution of it tightened or loosened the string as much as the whole circumference of the pin. By the new system a complete revolution of the tuning screw tightens or loosens the string only the width of one thread of the screw, requiring proportionately less force to operate it. Exact work is thus rendered easy.

The metal frame and fastenings are not liable to change. After a few tunings, sufficient to take out the mere stretch of the strings, they remain as set, and the piano hardly requires tuning at all. Moreover, it is not injured by tuning, as must be the case with wrest pins set in wood, as has been shown. These pianos are, evidently, peculiarly adapted to positions where tuners are not readily available, as well as to climates which involve trying conditions, not only as to temperature, humidity, etc., but also from ravages of insects, which in some countries so destroy the fiber of the wood that in a short time wrest pins lose their hold upon it, and the instrument becomes useless.

Other improvements of minor importance are included in these pianos. One is an improvement upon the French upright action, now very generally used, by which its capacity for rapid repetition of tones is much increased.

The cost of these pianos will be somewhat more than that of instruments constructed on the old system; but advantages obtained evidently warrant this.

The Mason & Hamlin Co. are well known as having been the first to introduce and manufacture the American organ, which has now become the most popular and largely used of large musical instruments. Their very successful experience in the manufacture of 150,000 organs has amply fitted them for the improvement of musical instruments, and given them a worldwide reputation which they would be very unwilling to jeopardize. They have, therefore, been experimenting with pianos several years, and testing their improvements in every way before being willing to give them to the public. They have now obtained and thoroughly tested results which warrant them in the extensive manufacture of their new upright pianos.

Fig. 1.—MASON & HAMLIN'S IMPROVED UPRIGHT PIANO.

The Burning of Iron and Steel.

Iron that has been raised to near its temperature of fusion and slowly cooled is designated as "burned" or overheated metal. It is both red short and cold short, and exhibits a coarse, crystalline structure and a bright glistening fracture. Such iron contains oxygen. But this oxygen is not, as is commonly believed, derived from without during the heating; but it was previously contained in the iron itself through the medium of the scoria or slag impurities mixed with it. When the iron is raised to the fusing heat, or near it, a chemical reaction takes place; the metallic iron reduces the sesquioxide to protoxide, which, by being dissolved in the iron, alters the properties of the latter. The coarsely crystalline quality of iron so treated is not due to the presence of the oxygen. The metal usually contains a notable quantity of phosphorus, which is well known to give a coarse grain accompanied by the quality described as cold short. The crystallization takes place during the slow cooling while at rest. The greater the proportion of phosphorus present, the lower is the temperature to which the iron may be raised without being burned. Pure iron should not take up more than 0·25 per cent of oxygen in solution. Though this substance does not greatly affect the ductility of the metal when cold, it acts like sulphur on its malleability.

The qualities of steel also undergo change when heated to a high temperature, or when subjected to a lower temperature for too long a time. The richer the steel is in carbon, the lower is the temperature at which the change takes place. Therefore, the harder the steel, the more carefully is it to be dealt with in the fire. Such overheated steel becomes coarse grained and brittle; that is, cold short. If the temperature be increased, showers of sparks are thrown off, and the steel is said to be "burned." The alteration brought about in this way has generally been attributed to a diminution in the proportion of the carbon constituent, though this assumption is not warranted by the results of analysis. The presence of manganese and silicon is of more weighty consequence. When steel containing these is heated it is not the carbon, but the manganese and silicon, that first becomes oxidized, and there results an important change in the properties of the steel. Later the carbon is oxidized; and while the oxide of carbon escapes, those of the manganese and silicon remain behind, and the whole molecular structure of the metal is altered. If the heating be carried still further, the iron will next be oxidized. A cast iron furnace door, exposed for several years to the flame of a coal fire, was found to contain 27·8 per cent of oxygen, in combination with iron, sulphur, nickel, copper, phosphorus, and arsenic. The cause of the sparks is not the combustion of the carbon, and the consequent generation of carbonic oxide gas, but the escape of gases imprisoned in the steel. Similar results may be brought about by exposing the steel to a lower temperature for a longer time; the oxidation of the constituents will, in this case, be effected in the order mentioned above, the only difference being in the slower action. Steel altered in this way is well described as "dead." A regeneration of the metal by mechanical treatment is hardly possible, since the original chemical composition cannot be restored by such means.—*Jahrbuch fur den Berg- und Huttenmann.*

An Interesting Relic.

A writer in the Panama *Star-Herald* says: Recently I had the pleasure of examining an old piece of Spanish ordnance. It is a brass breech-loading cannon, the property of our esteemed friend, the Bishop of Panama. The exact measurements of this shapely piece of artillery are as follows:

The diameter of the bore at the muzzle is three inches. Back of the muzzle band, on a raised square measuring two inches by two, is the letter R, for Rey. The circumference of the muzzle band is eighteen and a half inches. The circumference of the second band is thirteen inches. The extreme length of the piece is forty-four inches. The distance between the edges of the trunnions is nine and a half inches, their circumference is seven and a half inches, and their diameter two and one-eighth inches. The first part or swell of the breech, just back of the trunnions, measures twenty-one and a half inches. Circumference of the breech at its thickest part, twenty-one and a half inches. Thickness of its sides, one and a half inches. Internal diameter of the bore where breech block closed the gun, three inches and an eighth. In the upper posterior third of the breech, on both sides, are two slots, measuring two inches and a half horizontally by three-quarters of an inch wide. These undoubtedly were used for passing a transverse bar, that held the block in position during traveling and firing. In the under surface of the breech chamber there is an opening, square externally, measuring half an inch; it tapers off to a small round hole that enters the chamber about its center. One can hardly fancy that it was the firing hole. A careful examination leads one to suppose that as the block fitted with almost mathematical accuracy, this opening was probably left to allow air to escape in closing the breech, and permit rapid firing, etc. The measurements of the breech chambers are five and a half inches longitudinally by four and a half inches transversely.

The gun evidently was designed and cast upon well known scientific principles, such as are recognized to this day. The upper part of the breech lock, fitted under a strongly cast shoulder of brass, in the thickest part of the side of the bore, just inside the trunnions. As stated, the diameter of the bore anteriorly is three inches; posteriorly, three inches and an eighth. Did the early Spanish artillerists cover their shot with lead to secure accuracy of aim, and prevent the loss of the gases generated by the explosion of the powder?

The weight of this very interesting relic of the Spanish Main of "ye olden days" is probably 125 pounds. In view of its antiquity, the symmetrical proportions are excellent. While Lieut. Napoleon Bonaparte Wyse's expedition was in the Darien, three guns of this type were discovered and brought to Panama. The gun under consideration was presented to Bishop Paul, and the others are in the Paris Museum.

A NOVEL FIRE ESCAPE.

A bag or chute made of canvas or other suitable material, and open at both ends, is folded regularly and placed upon a truck provided with wheels and handles. One end of the bag is secured firmly to a frame hinged to the truck in such a way that when raised to a vertical position its lower ends will rest on the ends of the side bars of the truck frame. At the hinged end of the frame is arranged a cushion that can be placed over the window sill. The end of the bag is secured to the frame in such a manner that it can be entered through the frame. The frame is held in a vertical position by hinged side braces, and the top cross bar is of such length as to extend beyond the side bars of the window frame. The lower end of the bag is provided with handles.

To use the fire escape the truck is rolled to a window, the frame is swung to a vertical position, and the bag is dropped out of the window. The weight of the chute presses the top cross piece of the frame against the uprights of the window frame. The cushion is placed over the sill, and the lower end of the bag is held by a few powerful men, who grasp the handles, and thus prevent the bag from hanging vertically, as it is necessary that it should have

WINDMAYER'S NOVEL FIRE ESCAPE.

a certain inclination to prevent the persons from sliding down too rapidly. The people to be rescued step through the frame into the chute and slide down, the speed of the descent being checked by pressing the knees and elbows against the bag.

Further particulars regarding this fire escape can be obtained by addressing the inventor, Mr. A. J. Windmayer, of Fort Madison, Iowa.

Dispatch in the Machine Shop.

The importance of a reputation for promptness in the fulfillment of engagements, and the execution of orders on the very day they are promised, is well illustrated by an incident related in a contemporary, *The Industrial World.*

A short time since a party who contemplated having some expensive machinery made was inquiring where he had best send his order. A friend suggested the name of a well known machinist near at hand. The reply to this suggestion was: "While I know A to be one of the best machinists in the town, yet he is so proverbially slow that there is no telling when he would complete the work. I cannot afford to take the chances of his delays." A did not get the job; it was given to a firm who had a superior reputation for getting out work in a satisfactory manner with great dispatch.

This order was the beginning of a very large business, and it is safe to say that A's reputation for negligence lost him business the profits on which would, in a short time, have amounted to no less than ten thousand dollars. How many similar customers A has lost on account of his lax methods, no one knows. It is probable that his losses in this respect amount to many thousands of dollars, for he is only doing a limited business, notwithstanding his reputation for good workmanship is second to none, he being capable of successfully completing all sorts of the finer and more intricate mechanical work.

There is nothing that can be seemingly more vexatious than the customary delays in perfecting machine work. While it may be true that in this kind of employment there are numerous unexpected occurrences tending constantly to defeat the prompt dispatch of work, yet these difficulties are such as can be overcome by the display of extraordinary exertion and by paying a due regard to the minute details of the business. Machinists have frequently a fault of accepting orders for more business than they can do within the time stipulated. In their endeavors to fill their shops with work, they book more orders than they can take care of, and hence let their engagements get ahead of them, resulting too often in delaying important jobs, and in keeping everybody connected with the business in a bad temper.

It can readily be conceived that when a man orders a machine completed on a particular day, and has made his arrangements in accordance with a belief that the machinist will live up to his engagement, the disappointment in the event of a non-fulfillment must be very great, as in not a few cases is also the loss.

All that some people care for is to get the orders on their books, and little regard is paid to the time when they are filled. This is a wrong which will operate seriously to the discredit of the offending machinist.

If there were no loss of trade, no decline of reputation, or other ill-effects of the inexcusable course, a due regard for doing what is just and right should inspire the machinist to do his work promptly and in the best manner.

When a man leaves an order and agrees to pay a price for work done for him, there is an obligation on the workman's part to perform it in manner and form as agreed. Nothing avoidable should be allowed to prevent the honest consummation of this agreement.

There are occasionally valid excuses for the non-fulfillment of an agreement to get out machinery at a specified time. In such instances no blame can attach to the machinist, but it is safe to say that ninety per cent of the customary delays in machine shop practice might be prevented by intelligent forethought or by extra exertion.

Gumbo.

On the Canadian Pacific Railway, west of Winnipeg, it is noticeable that all the prairie land is free from stones. For great distances along the line, one bushel of stones could not be gathered in fifty miles. In the neighborhood of Brandon the soil is gravelly, and there are some large bowlders, which are striated in the east and west direction; these are the only bowlders to be met with for 400 miles from Winnipeg.

The absence of earth-worms and slugs is a marked feature of this soil. When dry, it is hard to work; during the summer it can scarcely be plowed; when wet, it adheres so hard to carriage wheels and boots, that it can only be removed by being scraped off. A very little moisture produces this state. It is very difficult to work in this condition, as it can scarcely be cast off the shovel or the scraper; with 20 per cent. moisture it somewhat resembles half-set mastic or glue. The most adhesive qualities of this soil are termed "gumbo." When "gumbo" dries, it bakes too hard to be plowed; on several occasions it was taken out with picks, in large blocks, and laid by hand in the dump. In its worst condition of moisture it will hold the hoofs of horses working in it and pull their shoes off; this has occurred repeatedly, and within one hour of their having been set. The authors kiln-dried and soaked some of it, and found it would absorb 72 per cent. of moisture before becoming "slurry."

The frost penetrates the ground to a considerable depth. In the excavations for the main sewer in Winnipeg some years ago, a layer of frozen clay, 12 inches thick, was found 8 feet below the surface in the month of August. The presence of frost in the lower layers of the subsoil is not prejudicial to the growth of the crop. The soil does not heave when the frost leaves it in spring, which is a marked difference to the clay subsoils of the eastern provinces. Houses can be built on sills laid on the surface of the ground; foundation walls or piles have to be carried down 8 feet. Frost has a beneficial effect on the earthworks, crumbling down the "gumbo" and causing it to fall like fine garden soil. It also consolidates the embankments.

Robert Henry Sabine.

This eminent electrician, who is well known for a variety of useful works, died in London on the 24th of October. Sabine was born at Dorchester on November 6, 1837, but subsequently lived at Bristol with his father, Mr. H. S. Sabine, a solicitor. Educated at Bristol, he entered his father's office at the age of seventeen; but manifesting a preference for engineering studies, he was sent to Manchester to enter an engineering firm, and there met the late Sir William Siemens, who engaged him as an assistant. In 1859 he went to the Mediterranean on H.M.S. Firebrand to test the Siemens deep sea thermometer, and afterward was transferred to the Berlin works of Siemens & Halske. He subsequently engaged in cable work abroad, and finally left Siemens, Halske & Co. to become a consulting engineer in 1867. In 1871 he became associated with Sir Charles Wheatstone in a private factory, which afterward developed into the British Telegraph Manufactory. Here the first Gramme machines were made, and many interesting experiments in electric lighting carried on. Sabine was married to Sir Charles Wheatstone's second daughter. For some years he was in partnership with Sir Samuel Canning. His best known works are the "Electrical Tables and Formulæ," which he prepared with Mr. Latimer Clark, and his "History and Progress of the Electric Telegraph," which, although overweighted with the productions of Messrs. Siemens Brothers to the exclusion of other inventors, is nevertheless a clear and correct work. His best known research is on a "Method of Measuring the Contour of Electric Waves passing through Telegraph Lines," and his most original invention is perhaps the "wedge and diaphragm photometer."

Correspondence.

Electricity from Machine Belts.

To the Editor of the Scientific American:

Seeing in this week's (Nov. 15) SCIENTIFIC AMERICAN and SUPPLEMENT notes about electricity on machine belting, in which I was very much interested, I concluded to send you a word of my experience, hoping some others may do the same, who may have it.

We have at present a very marked production of electricity on a pair of elevator engines in a very unfavorable place, it being in a basement of a large warehouse for stoves. This basement is very moist at all times, and the engines are well connected electrically through the steam pipe to boiler and feed pump, and to the ground by water main, also steam traps in the ground; the engines being set on large stone slabs. In spite of this, they at all times produce enough electricity to be seen. I have seen sparks 2¼ inches long, this being from the belt to nearest point on the frame of the engine. Another effect is that both kinds of electricity are produced, the electricity being reversed when the engines are reversed. When the belt is running from the lower side of drum pulley to engine pulley, positive electricity escapes from edge of belt to brake rod. When the belt runs in opposite direction, negative electricity escapes from the frame of engine to face of belt. To judge from the experiment I made, as below mentioned, a moist temperature does not seem to totally prevent the production of electricity. I have brushed the edges and face of belt with a handful of moist waste, after which the sparks were as usual. Even on rainy days I have noticed the sparks to pass the same, when I was not able to produce any with the plate machine.

I have no doubt about the sparks setting fire to combustible dust. I have burnt holes through papers of several thicknesses. The sparks are of a very bluish to a yellowish color, with a loud crack, the passage of negative being most bluish. I notice by running a wire across the face of belt, it reduces the size of the sparks, but it did not prevent the production of same. Have oiled the belts with castor oil without producing any change.

The elevator engines are made by Crane Brothers, of this city. They are a pair of 4,000 pounds capacity, double vertical engines, in the basement of the new stove warehouse of Rathbone Sard Co., running for two hours every working day.

I have no doubt there are engines in more favorable places than these which do not produce electricity. G. A. H.

Chicago, Ill., Nov. 17, 1884.

First Principles for Young Mechanics.

A well grounded knowledge of the great law or principle of conservation of energy should be taught with the multiplication table. It can be so taught if the teachers themselves are certain that there is in the universe only so much energy, and that we cannot make one particle more than already existed. With a clear understanding of this principle, no time will be wasted in search after perpetual motion machines, and fewer mistakes will be made by really earnest seekers after improved machines for use or improved methods. When a young man brings to me some wonderful improvement over the ordinary crank motion, some device that is to supersede the crank of the steam engine, a feeling of utter helplessness comes over me; I know not where or how to begin; he has had no opportunity to learn the simple laws of mechanics, and to point out the fallacy of his argument means to teach him the laws of mechanics, so I can only say to him, "Don't," and may advise him what books to read.

We hear or read almost daily of the wonders of science, and what is to be accomplished by electricity. "It is to be the great power of the future." Is it a power now? We may use it indirectly to drive machinery, we may make use of it to propel the cars on our street roads, but is it a power in the sense that steam is a power? Let us think of this a few moments. We call steam a power, and our factories are driven by steam power; or we call water when falling a power, and we drive the machinery in other factories by water wheels; or we pump water into the reservoirs at Fairmount by water power. Where we have no fall of water, and where fuel is scarce but wind plenty, we grind corn in a mill driven by wind, and the wind is our power; these and other sources of power may be called primary powers.

Secondary power is that which is transmitted from the prime motor to a machine. One machine may be driven by belt power, and another may be driven by gearing, etc. Electricity, as we now use it, as a power must be classed in its greatest economy with the secondary powers, with the belt or the gearing, not with the steam engine and the water wheel. We dig from the earth coal that contains the stored up energy of the sun's heat expended on forests that existed long before man came to live on this planet. We burn that coal under our boilers, and the steam generated by this application of heat to water is used to drive the piston of the steam engine, and from thence is the power conveyed by belt or gearing by shafts, or even by electricity, to the machines to be operated. We can burn up zinc in costly acids, and generate electricity that can be used to drive an electric engine, and so in turn operate machines exactly as in the case of the steam engine. In this case electricity is a power exactly as steam is to be considered as a power; and what is more, the electric battery will give us more nearly the whole of the stored up energy of the metal eaten up in the battery than the most improved steam engine can give us of the stored up energy of the coal that is devoured in the furnaces under the boilers. With all this advantage, electric batteries are not used to drive machines with any hope of economical results.

Zinc has been gathered from the earth as an ore, it has been converted into a metal, or the metal has been gathered from the ore by means of coal and much labor: its market price is measured by the cost of its production. To burn up zinc at five cents a pound in acids costing but few cents per pound, with a certainty of getting from the metal 70 or 80 per cent of its theoretical energy in motive force, yet makes the venture a more costly one than the burning of coal under a boiler with the knowledge that we are at the best getting but little more than ten per cent of the theoretical power that lies hidden in that coal. The electricity that is now lighting our streets, the electricity that is utilized in places to drive the street cars, has behind it the steam engine or the waterfall, the windmill or some other motor.

By means of a steam engine we drive a dynamo electric machine, and the electricity thence proceeding lights our streets or may be reconverted, with some loss, back into the power that created it; for one dynamo machine can be made thus to drive another, the electricity being carried from one to the other by proper conductors. What, then, is electricity as we now use it in the way of power, but as the belts and the gearing that carries our steam power to the machines? It is a belt with more or less slip. But this is not to remain so forever. The future of electricity as a power is full of promise. The coal we now squander, using but a small percentage of its theoretical dynamic force, is capable of yielding its energy either as heat or as electricity; and the time will come when we will not burn this coal to boil water, and in that boiling lose say 1,000 units of its heat at the moment of the conversion of water into steam, lose all this, never to be getting it back, but we will take from the coal its energy in the form of electricity, we hope in more near ratio to its true value, and then we can convert that energy into whatsoever other form of energy we may require. The best that science can do is to point out just what energy there is in this or that source of power. The most we can hope to utilize of this energy as power will never amount to 100 per cent. Nature gives us nothing without exacting something in payment.

A pound of water is the same as a pound of metal so far as its power from gravity is concerned. In falling through space it will exert just as much force as any other pound weight is capable of doing, and no more; it will do the work due to one pound falling at any given velocity less the friction of the machine or of the moving parts. We turn water into steam with a certain knowledge of the power that can be gained by using the elastic vapor as a spring, or we may tear the gases, which combined form water, apart, and use these gases in recombination to produce power, but less power than was taken to tear them apart, never more.

Science has made us so sure of these facts that we can base our faith on them, and with this knowledge we are willing that others than ourselves shall invest their money in machines which are claimed to be able to develop from five drops of pure water inclosed in a ball, power enough to propel the largest steamship across the ocean. It is ignorance of the unalterable laws of physics that leads ignorant people into squandering money on so-called wonderful inventions that, out of nothing, are to give us great results. An ignorant man will spend his time pondering over perpetual motion machines, so will a man with brain gone wrong; the first will quit his folly with more learning, the second finds his home in the madhouse. A third and worse class aim to deceive, and, for a time, many a one has done so. When shrewd ignorance resorts to dishonest methods, the confiding public is apt to suffer in pocket.—*Coleman Sellers.*

A Smoke Burning Locomotive.

A new locomotive, invented by Mr. Charles B Coventry, tried on the Chicago and Northwestern Railway, has given great satisfaction. During two succeeding weeks it has been on trial on the suburban trains on the Chicago, Rock Island, and Pacific. The poorest quality of bituminous coal was used, and yet at no time, although at one point it ran 50 miles an hour, did any black smoke come out of the stack. Not a particle of cinders and dust was thrown out. The smoke that was emitted was thin and white looking—much like escaping steam. There was no bad odor from escaping gas, as is the case in ordinary engines. Mr. Coventry explained that the gases on ordinary engines are usually thrown out of the stack, which is the cause of the density of smoke. On his engine the gases are all burned, and that is what causes the absence of smoke, which results, of course, in a saving in fuel. The new locomotive presents an entirely different appearance from those now in use. Instead of having a large, conical-shaped smoke stack in front, it has a straight smoke stack, similar to those in use on locomotives in England and Europe, in the rear just in front of the cab. The boiler has two sets of flues, small ones in the lower part and larger ones in the upper part. The smoke runs twelve feet through the lower flues, and then returns by the larger flues to the rear, where the smoke stack is placed. Thus the smoke traverses twenty-four feet before reaching the smoke stack, instead of twelve feet, as is the case in ordinary boilers. The heavy cinders and dust, not being able to rise from the lower small flues into the upper large ones, fall into a smoke arch in front and can be emptied on the ground at any time. There is another smoke arch to catch the lighter particles of dust and ashes at the end of the larger flues in the rear of the boiler. Thus nothing but a light white smoke passes through the smoke stack in the rear and no cinders, sparks, or fire is thrown out.

Oysters.

The oyster industry is rapidly passing from the hands of the fishermen into those of oyster culturists. The oyster, being sedentary except for a few days in the earliest stages of its existence, is easily exterminated in any given locality, since, although it may not be possible for the fishermen to rake up from the bottom every individual, wholesale methods of capture soon result in covering up or otherwise destroying the oyster banks or reefs, as the communities of oysters are technically termed. The main difference between the oyster industry of America and that of Europe lies in the fact that in Europe the native beds have long since been practically destroyed, perhaps not more than 6 or 7 per cent of the oysters of Europe passing from the native beds directly into the hands of the consumer. It is probable that from 60 to 70 per cent are reared from the seed in artificial parks, the remainder having been laid down for a time to increase in size and flavor in the shoal waters along the coasts.

In the United States, on the other hand, from 30 to 40 per cent of all the oysters consumed are carried from the native beds directly to market. The oyster fishery is everywhere carried on in the most reckless manner, and in all directions oyster grounds are becoming deteriorated, and in some cases have been entirely destroyed. It remains to be seen whether the governments of the States will regulate the oyster fisheries before it is too late, or will permit the destruction of these vast reservoirs of food. At present the oyster is one of the cheapest articles of diet in the United States, while in England, as has been well said, an oyster is usually worth as much as, or more, than a new laid egg. It can hardly be expected that the price of American oysters will always remain so low as at present: but, taking into consideration the great wealth of the natural beds along the entire Atlantic coast, it seems probable that a moderate amount of protection will keep the price of seed oysters far below the present European rates, and that the immense stretches of submerged land along our coasts especially suited for oyster planting may be utilized and may be made to produce an abundant harvest at a much less cost than that which accompanies the complicated system of culture in France and Holland. *G. Brown Goode.*

Animals as Barometers.

Says a writer in the *Cincinnati Enquirer:* I do not know of any surer way of predicting the changes in the weather than by observing the habits of the snail. They do not drink, but imbibe moisture during a rain and exude it afterward. This animal is never seen abroad except before rain, when you will see it climbing the bark of trees and getting on the leaves. The tree snail, as it is called, two days before a rain will climb up the stems of plants, and if the rain is going to be a hard and long one, then they get on the sheltered side of a leaf, but if a short rain on the outside.

Then there are other species that before a rain are yellow; after it, blue. Others indicate rain by holes and protuberances, which before a rain rise as large tubercles. These will begin to show themselves ten days before a rain. At the end of each tubercle is a pore, which opens when the rain comes, to absorb and draw in the moisture. In other snails deep indentations, beginning at the head between the horns, and ending with the jointure of the tail, appear a few days before a storm.

Every farmer knows when swallows fly low that rain is coming; sailors, when the sea gulls fly toward the land—when the stormy petrel appears, or Mother Carey's chickens, as they are called, predict foul weather.

Take the ants: have you never noticed the activity they display before a storm—hurry, scurry, rushing hither and yon, as if they were letter carriers making six trips a day, or expressmen behind time? Dogs grow sleepy and dull, and like to lie before a fire as rain approaches; chickens pick up pebbles, fowls roll in the dust, flies sting and bite more viciously, frogs croak more clamorously, gnats assemble under trees, and horses display restlessness.

When you see a swan flying against the wind, spiders crowding on a wall, toads coming out of their holes in unusual numbers of an evening, worms, slugs, and snails appearing, robin redbreasts pecking at our windows, pigeons coming to the dovecote earlier than usual, peacocks squalling at night, mice squeaking, or geese washing, you can put them down as rain signs. Nearly all the animals have some way of telling the weather in advance. It may be that the altered condition of the atmosphere with regard to electricity, which generally accompanies changes of weather, makes them feel disagreeable or pleasant. The fact that the cat licks herself before a storm is urged by some naturalists as proof of the special influence of electricity. Man is not so sensitive. Yet many people feel listless before a storm, to say nothing of aggravated headaches, toothaches, rheumatic pains, and last, but not least, corns.

A NEW ELEVATED TRAMWAY WITHOUT RAILS.

The question of the Paris Metropolitan Railway is the order of the day, and not a week passes without the presentation of some new project, which is very naturally superior to all others—at least in the mind of its promoter.

Whatever be the future in store for the one that we desire to lay before our readers on the present occasion, it would be difficult to deny it its dominant character—originality. The following is a resume of the considerations through which Captain Edward Mazet was led to invent his "New Metropolitan Railway without Rails, Cars, Bridges, or Tunnels." The sequel will show in what measure the system justifies its appellation. Two systems of metropolitan railways are in presence, viz., the underground and the elevated. Captain Mazet makes short work of the former of these: "What prevents and always will prevent the establishment of the first of these systems in such a city as Paris, is that it would have been necessary at the original formation of the city, in view of its present and future extension, to combine in advance the different routes that would have to be taken later on, without any possible entanglements, by the sewers, the water and gas mains, and the telegraph and telephone tubes, etc., and finally to make provision for a free and sufficient space in which a double track railway could run without the necessity of changing any of the sewers, mains, etc., now existing.

"But, as one could not foresee what Paris would become, any more than we can divine what it will be in future time, and as we are, moreover, convinced that this impossibility of divining will be perpetuated to future ages, we believe that we can put forth the opinion that the material and financial difficulties that have accumulated since the first tribe settled upon the banks of the Seine, up to our own day, will now and forever prevent the establishment of an underground line at Paris.

"In sum, the creation of such a line *should precede* the creation of the city in which it is to be established, since, when a city is in existence with all the arteries indispensable to its life, the material and financial difficulties that present themselves may be considered as insurmountable. In the second place, the creation of an underground railway *cannot precede* the creation of a city where it is to be established, since the necessity of such a line only makes itself felt when there is an agglomeration of inhabitants, that is to say, a city.

"We see that, on the one hand, they *ought to precede*, and that, on the other, they *cannot*, and so we conclude that city underground railways must be rejected."

Captain Mazet allows ten years for the construction of an underground, and passes in review the present means of locomotion, that have become entirely insufficient, in order to demonstrate that an immediate solution of the problem is necessary.

"It is necessary that we shall in six months be able to travel in Paris with a speed of 24 miles per hour, and that trains shall pass in all the principal streets every two minutes."

The following is the judgment that he pronounces upon elevated roads:

"Foreseeing the antipathy of the Parisian to an underground road, an endeavor had to be made to seek another mode of carriage, and, for a certain length of time, a project for a railway running over bridges has been under study.

"This would have required the erecting of bridges upon pillars in all the principal streets and boulevards, and it is upon these that the trains would have run on a level with the first stories of the houses, which then would have passed to the state of ground floors, while the shops, the ornaments of Paris, would have descended into the cellars. It would have been senseless—still more so than the underground. Paris, that coquette who passes all her time and spends all her money in embellishing herself, would have been forever disfigured.

"Hideous bridges of cold-gray cast iron, hiding the houses, the hotels, the *Opera*, would have proved a mortal blow to Paris, which would have soon passed to the state of a borough.

"Fortunately, the Opera was there, well seated upon its base; and strong in its majesty and popularity, it was able to say, 'You cannot pass!' This was the obstacle, the fortunate obstacle if there ever was one, that prevented the commission of a piece of foolishness without appeal.

"But, leaving the Opera out of view, would it have been possible to allow two elevated railways to pass in such streets as Montmartre, for example? These roads would have touched each other, and would have grazed the houses and completely closed the street. A new causeway would have been created on a level with the first stories, while horses and carriages would have moved about in a forest of cast iron pillars.

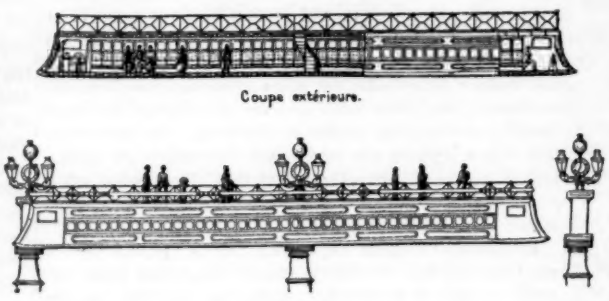


Fig. 1.

"Financially speaking, the affair was a colossal one. Mr. Songean, the president of the Municipal Committee, spoke of nothing less than a billion and a half. In face of these figures, which carry alarm with them, I shall go no further."

In the system proposed by Capt. Mazet there is no change made in the configuration of the city. In principle, it consists of a series of cast iron columns, 30 or 45 feet apart, upon which slides a boat or aerial car which is long enough to always rest upon *two* columns at once. This car is formed of double T irons connected by cross bars and diagonal stays made of light iron. The bottom slides, through the intermedium of rollers, in grooves in the columns serving as track

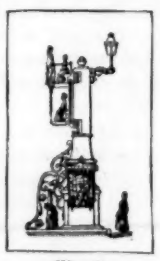


Fig. 2.

(Fig. 1). The engine room is in front, and the brake is at the rear. The rest is reserved for passengers. Fig. 2 gives a transverse section of the car, and shows how it is suspended, and also the form of the columns.

Fig. 3 is a perspective view showing the boat-cars running in the boulevards.

The lower part of the boat-car projects only about 3½ feet. Upon placing the columns in the line occupied by the trees, the external side of the car would be perpendicular to the edge of the sidewalk. The posts or columns replace the present lamp posts. They are about 15 feet in height, 4 feet in diameter at the base, and 20 inches at the top. The grooves are slightly fan-shaped on each side, to serve as a guide to prevent the car from missing a support, should the wind or vibrations give it an oblique direction.

"The motor may be either an electric one, supplied by Faure-Sellon-Volckmar, or Reynier, or Ayrton & Perry accumulators, or a steam one, without smoke, or a compressed air or carbonic acid one.

"If, in order to render the car lighter, or in order to obtain a greater seating capacity, the engine were done away with, the motive power would be furnished by a central station, which would set a roller or a wheel in motion.

"The lower part of the car, which passed over this roller or wheel, would be threaded so as to prevent sliding, and the car would follow its route by being carried along by the revolving rollers at each post.

"The power might be transmitted from the central station by means of an endless cable passing through underground tubes at the base of the columns, and actuating the rollers through intermediate gearing, or by means of compressed air, steam, electric conduits, etc."

We think it would be simpler and more practical to imitate what has been done in telpherage by Mr. Fleming Jenkins, to leave the motor on the car and lead the current from a central station by underground conductors, with contacts on each column. The endless cable arrangement appears to us impracticable. The same is the case with the system of propulsion consisting of a complication of racks and clicks, which would necessarily furnish abrupt and jerking movements.

We have no intention, however, of making a complete technical criticism of Capt. Mazet's project; it has sufficed to indicate the prominent lines of his very original idea. Carried out upon a small scale, it will obtain a certain success at fairs, and somewhat rejuvenate those wooden horses whose antique form is beginning to tire amateurs. Alongside of this recreative application there is another and more important one proposed by Capt. Mazet, and that is the use of the system for crossing rivers, marshes, plains, and precipices. This is shown in Fig. 4. Aside from the economic question resulting from the suppression of arches, and the facility of construction, a still more important advantage would be gained, and that is the facilitating of navigation through the rivers being no longer closed by those barriers which at present fix a limit to it. A glance at Fig. 4 will give a better idea of the matter than a long explanation.—*La Nature.*

Fig. 3.

Fig. 4.

Liquefaction and Color of Ozone.

The most important discoveries during the past three years concerning the properties of ozone are those made by Hautefeuille and Chappuis. They found that ozone is a blue gas, the color appearing sky blue even when only so much ozone is present as is obtained in the ozonation of the oxygen contained in a tube a meter in length by the silent discharge. Furthermore, they found that under very great pressures the condensed gas becomes indigo blue. If the pressure is increased to 75 atmospheres and then suddenly relieved, a dense white cloud is formed, showing the beginning of liquefaction, while the same phenomenon does not take place with pure oxygen until a pressure of 300 atmospheres is attained. The ozone must be compressed slowly and with constant cooling, otherwise it will explode with evolution of heat and light. By mixing the ozone with carbon dioxide, and then submitting the mixture to great cold and pressure, Hautefeuille and Chappuis succeeded in obtaining a deep blue liquid, the blue color being due to the liquefied ozone.

The same observers have studied the absorption spectrum of ozone, and accurate measurements of the same have been made by W. N. Hartley. The latter has extended the research to the absorption of certain parts of the sun's rays by atmospheric ozone. By this new optical method he has arrived at the conclusions: 1st. That ozone is a constant constituent of the upper atmosphere. 2d. That it is present in larger amounts in the upper than in the lower part of the earth's atmosphere. 3d. That it is the cause of the blue color of the sky.—*Prof. A. R. Leeds.*

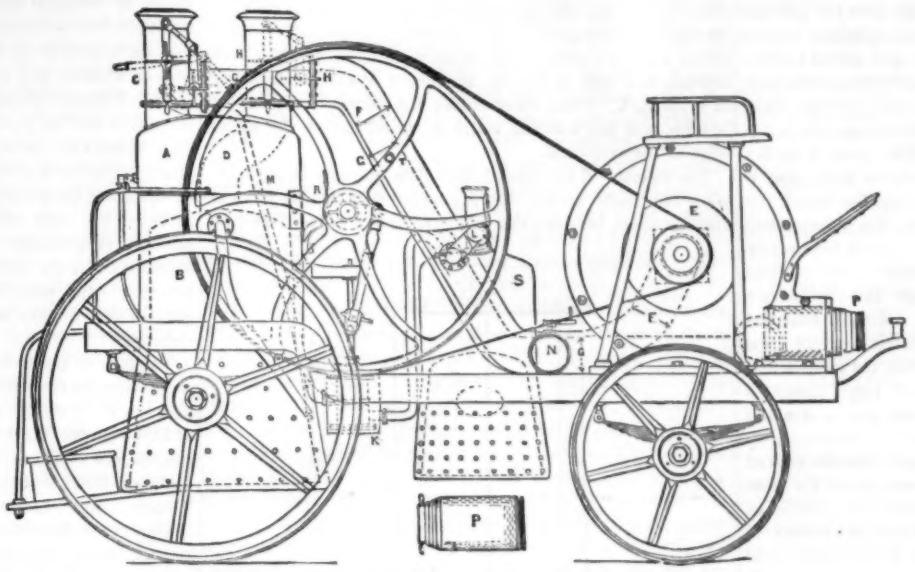
Scientific Ballast.

Some years ago a most interesting find of fossils was made at the Portland stone quarries. They were of high scientific value, and it was decided to send them to Yale College for preservation and study. They were accordingly loaded upon a flat car at Middletown and sent on their way, a car load of them. It was at that time that the fine stone bridge of the Consolidated road was being built across the Farmington River, at Windsor. After the arch of the bridge was set, the space was filled in on top with quantities of broken trap rock from the companies' quarries at Meriden. This broken stone at just this time was being drawn to Windsor by the cars for this purpose. The conductor of one train discovered the car load of fossils side tracked at Berlin, and felt sure that it was a lot of ballast for the Windsor bridge which had been accidentally left behind. With commendable zeal he fastened to it at once, and drew it on to the bridge. There the rare fossils were dumped with the other stones, and there to-day they lie in the solid flooring of the massive bridge.—*Hartford (Conn.) Courant*

THE CARBON BLAST.

We have recently had brought under our notice a new principle of extinguishing fires. It is the invention of Mr. John K. J. Foster, and is being introduced in London.

In our engraving, A is a boiler or the jacket of a firebox, B, in which a fire is burnt for the purpose of vitiating air. It has an uptake, C, for steam from the boiler or jacket, and another, D, for the products of combustion from the fire box, B. E is a fan drawing the products of combustion from the firebox, B, through a pipe, F, connecting the uptake, D, with the fan casing. G is a similar pipe connecting the steam uptake, C, with the discharge outlet of the fan. H H^1 are throttle valves coupled so that when H closes the outlet through the chimney, H^1 opens a passage through F to the fan, and *vice versa*. A similar pair of coupled valves, I I^1, control C and G. S is a small high pressure boiler supplying steam to an engine, K, which drives the fan. Its chimney is connected with pipe, F, by a pipe, L, and a similar pair of coupled valves is provided to control the communication. M is the exhaust pipe of the engine leading to the uptake, C, below the valve, I. N is an opening in the suction pipe, F, of the fan closed by a throttle valve, which is only opened when ordinary pure air is to be admitted to the fan to clear a room of the vitiated air after a fire. P is the delivery pipe of the fan, made of metal in short lengths, fitted together telescopically. Other similar telescopic pipes, P^1, may be added on by screw couplings, or the delivery pipe may be otherwise constructed. The fly wheel of the engine is connected to the crank shaft by a clutch, so that it may be thrown in and out of gear by a handle, *r*, to enable the fan to be driven by hand at first by a handle, T, on the fly wheel, for the purpose of creating a draught in the furnace of boiler, S, the valve, I^1, then being shut, and the fan drawing air through the pipe, L.



THE CARBON BLAST FOR EXTINGUISHING FIRES.

We thus have what theoretically appears to be a very perfect means of extinguishing fires, and which we hope soon to see tried in practice. Our engraving shows an engine adapted for fire brigades, but for mills and factories generally the fan may be so adjusted to the furnace of the ordinary boiler as to be ready at any moment. Steam may be allowed to mix with the vitiated ai if advisable.

The fan would draw the atmosphere through the fire box, the oxygen would be destroyed, and could be conveyed into any room in the factory at will by a fixed sheet iron conductor of sufficient dimensions, having branches with valves to communicate with every room. In case of fire the fan could be turned by manual labor, when, on the valve leading from main flue into the room that is on fire being opened, in two minutes the room would be filled with vitiated air and the fire extinguished.

This same appliance, by simply opening one valve and shutting another (automatically), could be used to exhaust the warm, fœtid air out of any or all the rooms in the factory, or to force fresh air into the rooms at will. The whole of this apparatus would be of little cost, and when applied in the case of small fires, could not do harm as in the case of extinction by water; 20,000 feet of cubic air per minute can be put into circulation by hand power alone. The apparatus in this connection would be stationary, and independent of any other appliance.

For use by railroad companies the hose could be attached to the funnel of an ordinary locomotive engine. In case of fire at a station or goods department, all that would be required would be to run the engine near the fire, attach the tail pipe of the fan to the funnel of the engine; the air drawn through the fire would be vitiated or deprived of oxygen, and conducted by the blast conducting pipe into the burning building, and the fire would be got under at once. Another important application is that of ships. For steamships the fan could in case of fire be attached to the funnel exactly as for locomotives. With Foster's carbon blast the vitiated air could easily be conveyed into any part of a ship's hold. If the hold, or any room in a vessel, was filled with vitiated air and steam, no fire could live many minutes. For ventilation purposes the apparatus would also prove very useful. In short, there appears to be a wide field of usefulness for this invention, and we look forward with interest to its practical introduction.—*Iron.*

THE making of large lenses is a matter of many difficulties, as may be inferred from the fact that there have been nineteen failures to cast the thirty-six inch glass for the great Lick telescope to be mounted in California.

Centenarian Women.

Mrs. Phœbe Brockway died at Union Springs, N. Y., on the 14th of November, 1884, at the remarkable age of 112 years. She had four children, of whom three are still living, Mrs. Marshall Whipple, aged 80, Mrs. Menzie, and William Brockway. Mrs. Brockway was well known as a strong and active woman, who enjoyed excellent health until within a short period of her decease.

At Beaver Brook, Mass., on November 14, 1884, the 100th year of the life of Mrs. Elizabeth Putnam was celebrated by her children. The aged lady is still very vigorous, memory and all faculties in good condition. She has had twelve children, six sons and six daughters, all of whom grew up and were married. Two sons and three daughters still live. All the children lived to be over 66 years of age except two, one of whom died at 30 and the other 34. There have been 42 grandchildren and 24 great-grandchildren, many of whom are living.

Yellow Dye.

A. Poirrier, of Paris, has taken the first step in the direction of producing a yellow dye, to compete with Persian berries; this is the *Jaune solide*, an azo color fixed with acetate of chromium. Poirrier has shown that it can be used like the Persian berry yellow, and that it can be sold cheaper. If fixed alone, the *Jaune solide* gives fine orange-yellow tints of much solidity, and resisting soap and light. —*Manchester Textile Recorder.*

THE COLLADON FOUNTAIN.

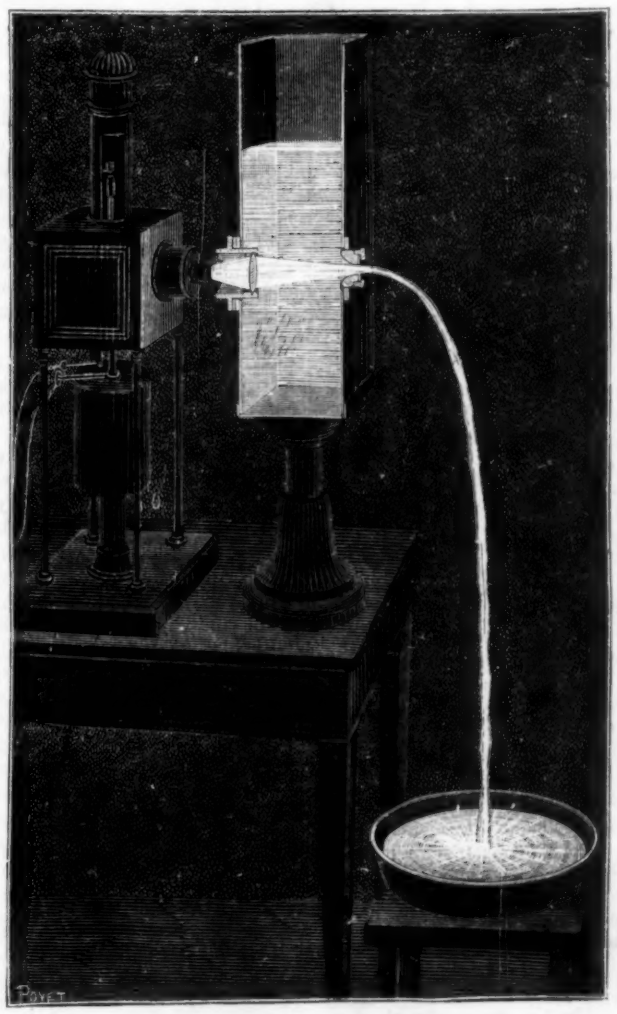
In my lecture courses I have often endeavored to render visible to all the pupils assembled in the amphitheater the different forms that are assumed by a stream of water issuing from various orifices, and it was for this purpose that I was led to illuminate internally a stream placed in a dark space. I have found that such an arrangement is well adapted to meet the object I had in view, and that, moreover, it offers in its results one of the most beautiful and curious experiments that can be performed during a course of lectures on optics.

The apparatus that I use for these experiments consists of an oblong vessel, about three feet in height, in one of whose sides, a little above the base, there is an aperture into which are screwed different diaphragms in order to vary the size and form of the jet. This latter escapes from the vessel in a horizontal direction. In order to illuminate it internally, an aperture is formed in the back of the vessel, and to this there is fitted a convex lens, while outside of the vessel there is added a short, horizontal, internally blackened tube designed to prevent the rays that are oblique with respect to the axis from entering the vessel.

The apparatus is placed in a dark room, one of the window shutters of the latter may be provided with an aperture for adapting the blackened tube to, and a fascicle of solar light may, by means of a mirror, be thrown parallel with the tube's axis. One may also employ with advantage an oxyhydrogen or electric lamp which throws a fascicle of horizontal light, as shown in the engraving. The luminous rays traverse the lens and the liquid, and converge in the aperture through which the stream is escaping; and when once they have entered the latter, they meet its surface at a sufficiently small angle to cause them to undergo a total internal reflection. The same effect is produced at every new point of incidence, so that the light circulates in the transparent jet as in a pipe, and follows all its inflections.

If the water be perfectly limpid, and the aperture of the diaphragm very sharp, the jet will be scarcely visible, although a very intense light is circulating within it. But at every point where the jet meets a solid body that interrupts it, the light which it contains escapes, and the points of contact become luminous. So, upon the jet being received in a vessel that stands horizontally, the bottom of such vessel will be illuminated by the light that issues from the apparatus through the jet. If the stream is falling from a great height, or if its diameter is but a few millimeters, it will be reduced to drops at its lower part, and it will be there only that the liquid will be illuminated, and every point of rupture of the jet will throw out a bright light. If a continuous jet is falling upon a surface capable of a certain number of vibrations, the vibratory motion will be communicated to the liquid, and the latter will then be broken to some height above the vibrating plate. This experiment of Savart, as well as several others that he has studied, and described in the *Annales de Chimie*, may be repeated and rendered visible by this new process. It will be understood, moreover, that it would be just as easy, by means of reflectors, to illuminate a jet that had any other direction, or to illuminate the interior of the jet with all the colors of the prism by interposing colored glasses between the lamp and blackened tube exterior to the apparatus. The only essential precaution to take is to use water at the temperature of the room in which one is operating, in order that no moisture may be deposited upon the lens. In experiments designed to render the jet visible near the orifice, in order to study the contractions of the stream, it is indispensable to render the liquid turbid by means of some solution or other or by dust. The light will thus be dispersed at the jet's exit from the orifice, and the liquid will become luminous at the upper part.

A fact that may be always observed with this apparatus is that slight blows against the vessel, near the orifice, made with a hard body, break the jet in the very plane of the orifice and produce therein true fissures, which are easily seen and which are very brilliant. Sometimes these fissures do not close immediately, but continue in the stream for some instants.—*D. Colladon, in La Nature.*



COLLADON'S FOUNTAIN.

CANVAS bags, it is said, can be made as impervious to moisture as leather by steeping it in a decoction of one pound of oak bark with fourteen pounds of boiling water, this quantity being sufficient for eight yards of stuff. The cloth from which the bags are made has to soak twenty-four hours, when it is taken out, passed through running water, and hung up to dry.

Old Furniture and New.

The present rage for old articles of household use, table decoration, and personal adornment is a whim of fashion, in many instances the coveted articles having no element of propriety in our modern life. Very few of them are valuable in the light of sentiment, having no association with beloved friends or with historical events.

But apart from these considerations the love for genuine old relics of furniture, especially, has an excellent reason for its being. There are really valuable and useful articles of household economy which unreasoning style has relegated to the second-hand furniture store, to the attic, or to the barn, or perhaps ruthlessly destroyed, and which have been replaced by modern articles far inferior. The present spring seat sofa with its tufted cushions and tortoise back seat is not half so inviting and restful as the old-fashioned, flat seated, broad sofa, long enough to receive the outstretched form of a six-footer, and broad enough to hold him safely if sleep overtook him. Many of these articles are of solid wood with no suspicion of veneering, and their forms are really more elegant than those of to-day. Modern veneered and upholstered furniture requires repairing every few years, or is worn beyond revamping within the recollection of a ten year old child. It is a source of regret that with the rage for antique furniture there is not also a demand for old time honesty in workmanship.

In spite of the sneer against the old style straight backed chairs, most of the old style furniture was made for convenience. There never was a more convenient article of furniture than the old desk and drawers combined—drawers below a folded-back desk, the back being pigeon holed, and the desk on hinges to be let down to form a writing shelf, and projecting far enough forward to give room for the writer's knees. The cupboard was another useful article for the kitchen or the dining room. It contained two or more wide drawers, with doors above them opening on shelves and racks, the whole standing on legs high enough to admit of sweeping under the cupboard. Memory recalls one, the framing and ends being of white walnut or hickory and the door panels and drawer fronts of cherry, both native woods, the creamy white of the hickory contrasting finely with the warm wine red of the cherry. These colors were set off by pendent pulls and door key escutcheon of polished ungilded brass that could be repolished and kept from the dilapidated appearance of the worn gilded brass of the present. Such an article of furniture would give an air of substantial comfort to any modern home.

The inferiority of modern made furniture cannot properly be attributed to machine duplicated work; it is as possible to make first class work by duplicating by machinery as by hand; else our hand tools and machine tools would be much more costly than they are. But it is undeniable that most of the furniture made within the memory of the elderly portion of the present generation compares favorably with that now made, in durability and integrity of workmanship. In these qualities it would be well if our manufacturers shared in the rage for the antique.

A Sheet of Letter Paper May Move a Ton One Mile.

The modern cargo steamer has now become a wonderfully economical freight carrier, especially as regards consumption of fuel. A freight train run under the most favorable conditions seems wasteful in comparison. The Burgos, a modern steamer especially built to carry cargo cheaply at a slow speed, lately left England for China with a cargo weighing 5,600,000 pounds. During the first part of the voyage, from Plymouth to Alexandria, the consumption of coal was 282,240 pounds, the distance being 3,380 miles. The consumption per mile was therefore only 83·5 pounds, and the consumption per ton of cargo per mile 0·028 pound. In other words, half an ounce of coal propelled one ton of cargo one mile. Assuming that paper is as efficient a fuel as coal, we have, says the *Railroad Gazette*, only to burn a letter on board this steamer to generate and utilize enough energy to transport one ton of freight one mile. It is difficult to realize that such a trifling act as burning a letter involves such a waste of useful energy, or can have any reference to the energy sufficient to perform a feat which, under less favorable circumstances, requires a couple of horses and a teamster for about half an hour.

The best locomotive performance in this country of which we can find any authentic record gives a consumption of about two ounces of coal per ton of freight hauled one mile at the rate of 13 miles an hour including stoppages. On lines having grades of from 53 to 70 feet per mile, the consumption often rises to 5 or more ounces of coal per ton of freight hauled one mile.

The engines of the Burgos are on what is termed the triple compound system, the steam being expanded in three cylinders in succession. The boiler pressure is 160 pounds per square inch. The average speed at sea in all weather is very nearly ten miles an hour.

A Beautiful Slide.

A very beautiful polariscope slide may be made, says the *Microscope*, as follows: Heat a slide until it will melt a small portion of a menthol pencil as it is drawn evenly back and forth over a perfectly clean surface. Do not use more heat than necessary to melt the material evenly. Then, as it commences to crystallize, arrest its progress frequently by passing the slide quickly over the flame of your spirit lamp; soon the crystallization will be completed, a little at a time, and a very desirable slide will be the result.

DR. OTTO GMELIN'S CUPOLA.

The cupola shown in the annexed engraving was invented by Dr. Otto Gmelin, of Buda-Pesth, for smelting iron, copper, or other metals, and has during the last few years won ground in Austro-Hungary, and is now also being introduced in Germany.

The illustration hardly requires any further explanation, considering the simplicity of the principle on which the furnace is constructed. Two concentric cylinders of boiler plates with two annular spaces between them, closed at the bottom, and open at the top, are placed on a foundation ring of brickwork. Cold water enters the annual space at the bottom, and the warmed water flows off below the upper edge of the cylinders.

The interior of the inner boiler-plate cylinder is, says *Engineering*, made rough, and is covered with fire-clay. The circular space between the two cylinders is covered over by

Fig. 1.

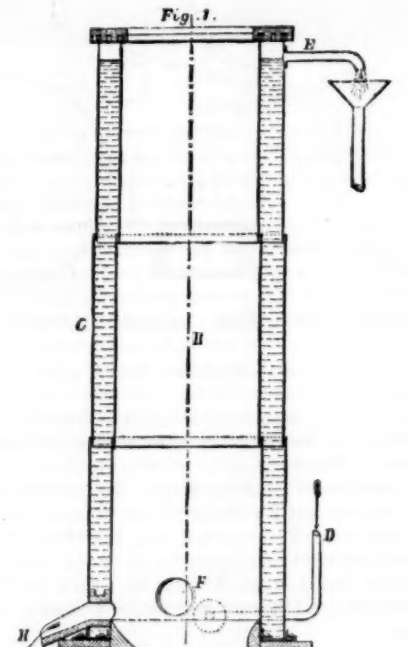
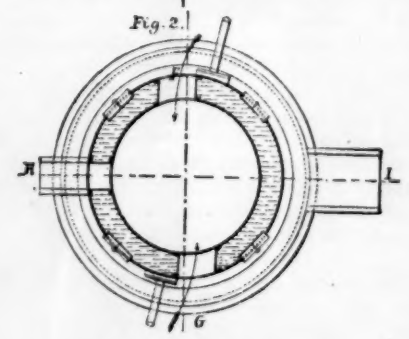


Fig. 2.



DR. OTTO GMELIN'S CUPOLA.

a cast-iron plate which lies loosely on the top of the two cylinders. Two circular grooves in the cast-iron top plate maintain the two cylinders at the correct distance from each other.

The outlet of the metal and of the slag takes place through tubular boiler-plate connections passing through the water space and attached to the inner and outer cylinders. The construction has lately been considerably simplified and strengthened by making the inner furnace cylinder of a welded tube, with tubes for air inlets welded on all in one piece.

The novelty of the above construction consists chiefly in the cooling of the smelting furnace by water without using an air-tight water space. The inner cylinder can expand and contract without any resistance as the temperature in the furnace changes, and the consequence is that repairs are hardly ever required. The first furnace built upon this principle has now been at work daily for the last 2½ years without ever having required any repairs to the boiler plates of the cylinders. The smelting operations can therefore also be kept up for any length of time without interruption. The energetic cooling of the inner smelting cylinder, which takes place with this system of furnace, is also stated to afford advantages as regards the saving of fuel (equal to 6 to 8 per cent) and the decrease of burnt metal as well as the good and equal quality of the castings. The upper part of the furnace never gets hot, and the coke does not begin to burn until it arrives at the lower part of the furnace, where the smelting process takes place. The carbonic acid formed here escapes unchanged without being reduced to carbonic oxide as it passes through the upper charge of the furnace. The metal thrown in at the top of the furnace arrives completely unchanged into the smelting zone, where it is brought to the smelting point at once by a very strong blast.

The furnace remains always round and smooth, which is also a very important feature with regard to economy of coke and good quality of the castings. It is likewise unaffected by chemical action, and the quality of the castings will therefore be considerably improved by the fact that this furnace admits of an addition of any quantity of basic substances without any risk of damage.

This furnace offers special advantages in cases where scrap iron can be had cheaply, as on account of the small consumption of coal and silicium much more scrap iron than usual can be used along with the pig iron, without any fear of obtaining hard castings. The arrangement also offers advantages in cases where it is necessary to produce special qualities of castings—for example, hard castings—as the foreman can with much greater accuracy calculate the proportions of the materials to be put into the furnace to procure an even quality throughout, than he can with ordinary cupolas.

The firm of Ganz & Co., of Ofen, who have a very high reputation for their chilled rolls, is now altering all its furnaces to Dr. Gmelin's principle, and a number of other firms of high standing have also adopted Dr. Gmelin's furnace; namely, the machine factory of the Hungarian Government Railway, Buda-Pesth; the Ozterr Alpine Montangesellschaft, Vienna; the Austro-Hungarian Government Railway, Vienna; the Eisenhutte, Undine; Count Waldstein's Iron Works, Sedlec, Bohemia; and Howaldt Brothers, Kiel, Germany.

A Mexican Iron Mine.

A correspondent of the *Alta California*, describing the wonders of the Cerro del Mercado in Durango, owned by the Durango Iron Mountain Co., of Chicago, says that the vast deposit comprising it is not a mine, but a yard for storing iron ore, the floor of which is iron. Its dimensions are grander than all the combined iron ore yards of Europe, added to all that there are in the United States. It is nearly a mile in length, nearly a fourth of a mile in width, and towers 650 feet above its ponderous base. This is, I have reason to think, not one-hundredth of the ore in the property—40,000 acres—which comprises the area covered by the company's purchase, for the mountain above ground, which measures fully one billion tons of ore, is but the peak of an immeasurable mountain, which nature has, in no exceedingly remote period, formed by eruptively metamorphosing other forms of iron ores than the prevailing ones, which at present comprise the mountain. At one-fourth and one-half mile points from the base of the iron mountain, on the company's grounds, are other lesser peaks of iron. The low intervening lands are but coverings over iron ore.

The iron ore of the deposit has no intermingling rock, no debris like clinkers out of or from a huge smelting hearth. The ore is magnetic oxide, producing a forged iron equal to the best in the world and far superior to the English, because made with charcoal and because there is abundant reddish oxide of iron present, which affords a liquid very necessary for the elaboration of steel. The whole mountain undoubtedly will yield an average of 62½ per cent, or five-eighths iron of the weight of the ore. Charcoal, for the making of which there are worlds of forests, is cheap, and so is labor. The ore is in bowlders. It is already mined. This is ore that is unusually magnetized. A piece of it attracts the needle at one end and repels it at the other. There is limitless coal on the Pacific slope should any but charcoal be needed. All needed accessories for mills for working iron ore after being smelted, and for manufacturing purposes, are near at hand. There is a great abundance of both heavy and light building timber, water for power, moulding and building sand, fire-brick clay, stone, lime, and the Murga River on the grounds. Mexico, by her heavy duties on iron, shields the owners of Iron Mountain. Nails, spikes, horse-nails, wagon and other springs, are charged 5½ cents per pound. Plate iron for tin (and ores of the latter are abundant) is 6 cents per pound; steel is 3 cents; iron chain, 4½ cents; iron columns, much needed in the styles of architecture used generally, are 13 cents duty per pound; screws of all kinds and iron bedsteads, 8½ cents per pound. This grandest of all iron deposits known to man is so conveniently located, so cheaply worked, and its product so pressingly demanded by the wants of its 12,000,000 people, that in the mining and metallurgical world it is peerless as an industrial enterprise.

A Chance for American Inventors.

Senor Don Matias Romero, the Mexican Minister, has transmitted to the Secretary of State, at Washington, a decree issued by the State of Yucatan, Mexico, offering a prize of $20,000 to the inventor of a machine which shall successfully extract the fiber from henequin, under the following conditions: It must be automatic and not require skilled and experienced workmen to manage it; it must be entirely free from danger to the operators; it must require less motive force than the machines now in use with relation to its producing power; it must increase the production or extraction of the fiber within a given time, diminishing its loss, compared with the various machines in use. The reward is to remain open for three years, and is without prejudice to the right of proprietorship and of patent.—*The Iron Age.*

Wood Preservation.

One of the greediest mouths which the forests of the United States are required to fill is that of the railway demand for ties, bridge timber, etc. According to Poor's Railway Manual, there were in the United States at the close of 1883, 121,592 miles of railways. The average number of ties needed per mile of track is 2,820, and the duration of a tie averages about six years; hence the annual consumption of ties by all the railways of the country amounts to the stupendous total of 57,148,240. This number of ties represents, at the lowest estimate, 144,208,933 cubic feet of timber, enough to make 1,714,447,700 feet of lumber. At 20 cents a tie, the value of the ties laid yearly foots up $11,429,648. The amount of white pine cut in the Northwest in 1883 was not four and a half times larger than the above figures, a comparison that readily shows how much timber this one branch of the railway industry demands.

It must be borne in mind that we have only given statistics here of the number of ties required for the existing railways, but this large total is being continually increased by the construction of new lines of road, and we have omitted any estimate of the quantity of timber in other forms required for railroads, wharves, bridge timbers, etc., etc,

In view of this enormous draught on the forests of the country, it is evident that the time is approaching when scarcity will cause an advance in price. The not remote prospect of such an advance, as well as the present economy of a proper preservative treatment, has induced several railroads in the United States to conduct experiments looking toward some feasible means of timber preservation; and the American Institute of Civil Engineers has been for some time past collecting information regarding the various processes for this purpose, with the object of embodying such information in a report to be shortly given to the public. The question of timber preservation is one of national importance, and as it is the aim of this journal to keep its readers informed in regard to everything connected with the lumber interest, we do not think we need to apologize for devoting considerable space to an account of the causes of the short life of timber used by railways, together with a description of some of the methods for its preservation.

There are two principal causes of the destruction of timber in use by railways, namely, decay and mechanical wear. When wood is exposed to the atmosphere, its decay may be considered a species of fermentation set up by the combined action of heat and moisture in the watery and albuminous constituents of the wood, which gradually convert it into *humus*, or rotten wood, this process being at the same time expedited by the presence of numerous boring insects, which take up their abode in the cells of the decaying wood and feeed upon its juices.

The object of any rational treatment for preserving wood is the coagulation of the albumen by substances capable of effecting this; of these the most effectual, as well as the most practical on account of its low cost, is creosote, which exercises a powerful action in the coagulation of the albumen, and is also so destructive to all kinds of insect life as to completely exclude them from any wood which has been treated with it; the presence of a sufficient quantity of creosote in any liquid at once and completely arresting fermentation for an unlimited time, and destroying all germs of animal and vegetable life.

Of the substances containing creosote, the two most important, and in fact the only ones available for this purpose, are coal tar and wood tar. When coal tar is distilled in iron vessels there is produced, in addition to other substances, as naphtha, etc., about 30 per cent of the so-called creosote, or dead oil, which has since 1850 been used in continually increasing quantities for this purpose. The quantity of coal used for gas making in Europe is about 10,000,000 tons annually, producing about 5 per cent of tar, yielding about 150,000 tons of dead oil, the whole of which is available for treating timber. There is also a very large quantity of coal tar produced as a by-product of the gas manufacture in the United States, but excepting in a few cases nothing has been done toward utilizing the dead oil contained in it.

The second substance, wood tar, referred to above is the tar produced by the destructive distillation of wood for the manufacture of charcoal. Considerable quantities of this substance are produced, but as yet it has been only considered as a waste substance or available for fuel.

As wood tar contains a large percentage of true creosote, which is entirely absent in the case of coal tar, it is a better preservative of timber than any of the constituents of coal tar, and recent experiments have demonstrated that it may be used by itself for this purpose if forced into the cells of the timber while heated and in a fluid state. Many other substances have been proposed for treating timber, but on account of their cost and the comparatively small quantities produced are not available to any important extent for this purpose.

The method of treatment which is generally considered to be the most thorough, practical, and rational is that which involves first the subjection of the timber in close vessels to the action of high pressure steam for a sufficient length of time to enable the steam to penetrate all the cells of the wood and to vaporize the liquids contained therein, these being afterward removed by a vacuum pump. After this preparatory treatment the preserving substance is forced into the cells of the wood under powerful pressure, the quantity of this substance being regulated according to the use for which the timber is destined. If simply to be used for bridges or elevated structures, the quantity of the preserving substance required is less than for ties, and if for use under water or exposed to the attacks of the teredo the largest amount which can be forced into the wood becomes necessary.

The apparatus needed for treating timber by this method is simple and comparatively inexpensive. It consists of a cylinder of boiler plate, the size of which depends upon the dimensions of the timber to be treated. This cylinder is made strong enough to resist a pressure of 300 pounds per square inch, and has a track extending for its whole length along the bottom, the ends of the cylinder being closed by strong iron doors, provided with suitable means of rendering them air and water tight. Iron cars, having wheels of small diameter fitting the track on the bottom of the cylinder, are provided to carry the timber or ties while under treatment. A steam boiler with vacuum and force pumps, and also reservoirs fitted with steam coils for containing and heating the preservative substance, are also provided. The operation may be briefly described as follows:

After the cars loaded with the timber for treatment are run into the cylinder and the doors closed, steam at about 100 pounds pressure is injected into the cylinder, and the supply continued for a length of time depending upon the nature of the wood and its dryness. The steam is then shut off, and the vacuum pumps started and kept at work as long as any liquids or vapors are obtained. The vacuum pumps are then stopped, and the hot preserving liquid allowed to flow from the reservoir into the cylinder until it is filled. After this the force pumps are started, and their action maintained until the pressure in the interior of the cylinder rises to about 100 pounds per square inch, the pressure being maintained at this point until a sufficient quantity of creosote oil or other preservative liquid is forced into the cells of the wood. The force pumps are then shut off, and the creosote oil or other liquid contained in the cylinder discharged into a suitable cistern, after which the doors at the ends of the cylinder are opened and the car carrying the timber or ties run out.

When wood has been creosoted in the manner described, paying proper attention to the complete removal of water and juices previous to the injection of the creosote, the density of the wood will be found to have considerably increased, and that its tenacity for holding spikes, etc., as well as its ability to resist mechanical wear, has also increased to a very notable extent. One of the Southern railroad constructors stated some time since in a report on this subject that in his opinion (we quote from memory) a soft wood tie properly creosoted is much more valuable, both as regards resistance to decay and to mechanical wear, than the best white oak tie; in fact, he considered creosoted soft wood ties worth $1 each for railroad use.

One of the principal causes of the rapid destruction of ties from mechanical wear is imperfect road beds, but we think that as ties become less abundant and more valuable, more attention will be paid to devices for protecting them from the direct action of the rails; and, as the life of a creosoted tie when exposed to decay alone, is practically unlimited, the advantages of creosoting will under those circumstances become still more apparent.

The principal item in the cost of preserving is the quantity and cost of the preserving substance. In the case of ties, three gallons of dead oil or of wood tar will be required, while for bridge timbers a smaller quantity will suffice.

The cost of treatment, aside from the cost of the preserving agent, will not in the case of ties vary much from 5 cents per tie. The cost of dead oil ranges from 7 to ten cents per gallon.

Ties for creosoting should be carefully selected, as it is manifestly poor economy to creosote a tie in which decay has already commenced.

The necessity of a most thorough preliminary treatment of the ties for the removal of fermentable substances cannot be too strongly insisted upon, as the value of the subsequent preserving process depends almost wholly upon its proper performance, and its neglect has been the cause of frequent failures in wood preserving operations. It is not long ago that complaints were made in some European journal that creosoted beech wood ties became rotten in the middle of the tie, while the outside for an inch or two in depth remained perfectly sound. The reason for this condition of the tie seems clearly traceable to neglect of a proper preliminary treatment of the tie; the water and juices had been removed from the surface of the tie, but not from the interior. Consequently, the creosote oil was unable to penetrate that portion of the tie on account of the cells being already filled with water.

We do not wish to be understood in this article as advocating the immediate adoption in all cases of wood preserving processes, for this will depend largely upon the cost of the ties. In many localities their cost is still so low as to preclude any treatment of this kind, but there are many others in which their cost has already increased beyond the point where creosoting may be profitably employed; the area of such localities is continually increasing, and it needs no prophetic vision to foresee that in the near future the adoption of some preservative process for wood will become universal.—*N. W. Lumberman.*

THE *Quarterly Therapeutical Review* says methyl salicylate (oil of wintergreen), mixed with an equal quantity of olive oil or linimentum saponis, applied externally to inflamed joints affected by acute rheumatism, affords instant relief, and, having a pleasant odor, its use is very agreeable,

Patent Office Business, Fiscal Year 1883-84.

Hon. Benjamin Butterworth, the Commissioner of Patents, has made a report to the Secretary of the Interior of the business of the Patent Office for the fiscal year ended June 30, 1884. For purposes of comparison we add to the figures thus presented those for the preceding fiscal year, as follows:

Applications.	Fiscal year to June 30, '84.	Fiscal year to June 30, '83.
For patents	35,204	32,845
For design patents	1,322	1,089
For reissue patents	244	247
For registration of trade marks	1,077	854
For registration of labels	975	749
Total	38,822	35,734
Caveats filed	2,673	2,686
Patents and Trade Marks Issued.		
Patents granted, including reissues and designs	22,822	21,185
Trade marks registered	909	886
Labels registered	833	618
	24,558	23,686
Expired and Withheld for Non-payment.		
Patents withheld for non-payment of final fees	2,461	2,036
Patents expired	10,230	7,471
Receipts and Expenses.		
Receipts from all sources	$1,145,433	$1,095,884
Expenditures (not including printing)	901,413	677,628
Surplus	244,020	518,255

The number of applications awaiting action by the office June 30, 1884, was 9,186, an increase of 5,087 over the accumulated applications at the end of the preceding year.

Firefly Light.

MM. Aubert and R. Dubois have recently made a number of interesting observations on the light emitted by "pyrophores," or fire-bearing insects of the family Elateres, genus Pyrophorus. These pyrophores have three luminous organs, one situated at the ventral part, and two at the superior part of the prothorax. The last are always visible, and were submitted to the tests. The light was produced by rubbing the insect with a light brush, and was examined by means of an ordinary spectroscope with a prism of very refrangible glass and a micrometer. The spectrum was very fine, continuous, and showing neither brilliant nor dark rays. This peculiarity has already been pointed out by Pasteur and Gernez, who studied the light from a pyrophore belonging to the late Abbé Moigno, editor of *Les Mondes*. The spectrum occupied about seventy-five divisions of the micrometer, and extended on the red side to the middle of the interval which separates the rays A and B of the solar spectrum, and on the blue side a little beyond the ray E. When the intensity of the light varied, its composition changed in a remarkable manner. When the brightness diminished the red and orange disappeared entirely, and the spectrum consisted of green, and a little blue and yellow. The green rays lasted longest. The contrary took place when the light grew in brightness, the green appearing first and the spectrum extending a little on the blue and a great deal on the red side. The least refrangible rays are therefore emitted last. No other luminous source known appears to behave in like manner. The only case which bears a resemblance is that of sulphate of strontium becoming phosphorescent under the action of light at a growing temperature. As the temperature rises, rays less and less refrangible appear in the spectrum, but at the same time, as Edmond Becquerel has shown, the less refrangible rays disappear. When the light of the organ begins to appear, the central and forward part only of the organ is luminous. It is only when the light is very bright that the periphery of the organ is luminous, and then the red rays are visible. The light was found to give photographic images on a gelatino-bromide plate; the insect being two centimeters from the plate, and the time of exposure reduced from an hour to five minutes. The photographs show that the light of the pyrophore is capable of producing intense chemical effects, if the smallness of the quantity emitted be taken into account. The light also determines the phosphorescence of sulphate of calcium, after an exposure of five minutes; and eosine and azotate of uranium are rendered fluorescent by it.

Natural Gas vs. Coal.

The steadily increasing use of natural gas in Western Pennsylvania, West Virginia, and Ohio, for manufacturing purposes as well as for lighting, suggests the possibility that its employment may soon have a depressing effect on the anthracite and bituminous coal business over a considerable section of country. A Pittsburg paper, referring to this matter, says: "In so far as natural gas has been applied to the manufacture of iron, steel, and glass, the quality of the products is rather in its favor. For steam raising it is very superior to solid fuel, not merely in the lessening of labor and freedom from ashes, but in that the heat can be more equally distributed lengthwise and around the boilers, to the benefit of the latter in the matter of safety and durability. It is safe to say that the use of gas fuel in this locality now supplants the use of several thousand tons of coal each week, and there is no doubt that the use of gas fuel will largely increase in the near future. Coal proprietors who have depended upon manufactories for their business already feel the local rivalry of this wonderful and valuable agent for the industries, and this competition between coal and natural gas can only be measured by the gas developments of the future."

ENGINEERING INVENTIONS.

A car starter has been patented by Mr. Jacob J. Anthony, of Sharon Springs, N. Y. The invention consists of a compound lever and ratchet mechanism, that can be operated by hand or foot for the development of power, by which street cars may be started or stopped, or the device may be used with steam cars for making up trains, thereby dispensing with locomotives for this purpose.

AGRICULTURAL INVENTIONS.

A check row corn planter has been patented by Mr. Jo l Kirkwood, of Mauzy, Ind. This invention covers a special construction and arrangement of parts to make a simple, efficient, and durable machine for planting corn or other seeds in accurate check rows.

A hand cultivator has been patented by Mr. Judson B. Hurd, of Hardin, Texas. It is made with a plow plate having wings bent to destroy the grass and weeds and leave the soil level, while with the plow beam and winged plow are connected two or more rotary cutters, whereby the soil, roots, grass, and weeds will be cut in parallel lines in front of the plow plate.

A plow standard has been patented by Mr. John R. Sampson, of Bennettsville, S. C. It is made with a ground bar and a beam plate arranged with the forward parts at a greater distance apart than their rear parts, and connected at their forward ends by a front bar, so the plow plate can be moved up and down to vary the angle at which its cutting edge enters the ground, as the work and the character of the soil may require.

MISCELLANEOUS INVENTIONS.

A churn has been patented by Mr. James H. Taylor, of Westfield, Mass. This invention covers a special arrangement and construction of parts for making churn barrels or cylinders whereby the parts thereof may be conveniently set up and tightened or loosened as desired.

A chimney cowl has been patented by Messrs. Martin Ludwig, James S. Barber, and John S. Barber, of Beloit, Kansas. This invention covers a novel construction whereby a stationary cowl is adapted to prevent downward currents of air in the chimney when the wind is blowing from any direction.

A pegging machine has been patented by Mr. Hans Schurhuber, of Vienna, Austria. This invention covers a new and improved pegging machine for fastening the soles to shoes of all kinds, being especially designed to do the work thoroughly, rapidly, and with a superior finish.

A peg wood sharpener has been patented by Mr. William G. Scott, of Batesville, Miss. This invention provides a simple and convenient implement for the use of jewelers and others for sharpening rods of peg wood employed in cleaning the pivot holes of watches, clocks, and other small machines.

A coal cleaner has been patented by Mr. William H. Shepherd, of Pittston, Pa. This invention provides a new and improved machine for separating slate and rocks from coal by means of screens and a current of air, and is an improvement on a former patented invention of the same inventor.

A vessel for dispensing fluids has been patented by Mr. Peter Hartmann, of Brooklyn, N. Y. This invention provides a vessel in which volatile liquids may be kept from air, and yet sufficient may be supplied for use as desired, the main body of the liquid, by this novel construction, being protected from exposure.

A pyrethrum soap has been patented by Mr. Johann Zacherl, Jr., of Unter Dobling, near Vienna, Austria-Hungary. It contains an addition of the soft resin which forms an ingredient of pyrethra plants and contains the insect killing stuff, the soap being especially designed for destroying insects and other parasites.

A casing for pipes has been patented by Messrs. James F. Wood and John F. Wood, of Wilmington, Del. In combination with disks adapted to surround a pipe are open tubular casing sections surrounding the disks, each having at one longitudinal edge and at one end a pocket, the free edges of the sections being held together by nails, pins, etc.

A mail bag fastener has been patented by Mr. Charles W. Jefferson, of Rugby, Tenn. Steel strips are fastened on the sides of the mouth of the bag, one side being adapted to overlap the other, and the overlapping part being provided with a staple projecting from its inner surface and adapted to be passed through the strips and the closed top of the bag.

A whip has been patented by Mr. Ephraim M. Turner, of Fort Worth, Texas. In combination with a spring wire core and rubber compound covering of the body of the whip is a metallic coupling and a detachable screw whip handle, made to form a clasp knife, such whip being more especially designed for stock farmers or those of like calling.

A safety attachment for elevators has been patented by Messrs. John D. Phyfe, of Demarest, and James J. Harold, of Tenafly, N. J. It consists in the application of revolving wheels or cylinders, with studs arranged to come in contact with suitable fixed detents, in case the elevator rope should break, furnishing a positive lock to the falling of the elevator cage.

A lock faucet has been patented by Messrs. Richard W. Howard and Charles B. Locke, of Apponang, R. I. Its construction is such that a barrel may be connected by pipe with a room above, and liquid may also be drawn from the barrel through the lower end of the cock without disconnecting said pipe, while by suitably turning the cock egress either way may be shut off.

A fruit jar has been patented by Mr. Nathaniel W. Krouse, of Haysville, Pa. The construction is such that, when both cover and jar are of glass, the contents can only be exposed to contact with glass, and the jar, besides complete locking arrangement, has a bail of peculiar construction, which helps press down the seal and also forms a convenient means for carrying or handling the jar.

A crucible or casting ladle has been patented by Messrs. Jacob F. and Ernest G. Zimmerman, of Hanau, Germany. It has an inner and an outer triangular vessel, the inner one with its angles crossing those of the outer vessel, and with downward sloping sides and apertured bottom, so constructed as to retain the slag and prevent its being poured out with the molten metal.

A stop watch has been patented by Mr. Eugene J. A. Dupuis, of New York city. This invention covers a modification of the levers for operating the fly backs, and the pawls for operating the ratchet wheels that start and stop the chronograph mechanism are made of a single piece of spring metal, thereby being simpler and occupying less space, with other novel features of construction and arrangement of parts.

A hot air furnace has been patented by Mr. Nathaniel A. Boynton, of New York city. It affords a novel construction of the dome and radiator and their flues or passages, and arrangement of the dome within the radiator, insuring compactness and a more effective circulation of the products of combustion, with enlarged heating and radiating surface, the flues being caused to clear themselves of soot.

A watch case has been patented by Mr. Jacob Macher, of New York city. By this improvement the key, or combined key and push pin, can be withdrawn sufficiently from the pendant to clear the inner edge of the center, thus permitting the works to be passed into the case, but the push pin or push pin and key cannot be withdrawn entirely from the pendant.

A can holder has been patented by Mr. John W. Edwards, of Seattle, Washington Territory. A basket, or cage, adapted to hold a can or carboy, is made to swing easily between two specially devised brackets, so it can be tilted very easily to draw off the contents of the can or carboy, the device being also especially designed to facilitate drawing off the contents of heavy vessels.

A machine for making and inserting umbrella frame rivets has been patented by Mr. Daniel M. Redmond, of Philadelphia, Pa. The wire is forced through tubes and clamped, and, the rib and brace being brought into position, the wire is cut off and headed therein, the operation being performed with great rapidity and ease, and the machine being adapted to different sizes of wires.

A printing press has been patented by Mr. Peleg S. Dodge, of Stanton, Mich. This press has a reciprocating flat form bed, over which is mounted the impression cylinder, and in the frame underneath, or otherwise equivalently arranged, is the steam cylinder of a direct acting horizontal steam engine, whose piston has a stroke equal to one half the circumference of the impression cylinder, and power is thus directly applied to run the press.

A knock down barrel has been patented by Mr. James H. Miller, of Hearne, Texas. This invention affords a cheap and easily constructed barrel for shipping fruits, etc., affording a free circulation of air; wooden slats or staves of proper lengths are secured to two or more hoops, which may be readily bent around a hinged head, and fastened by loops in the hoops, but the barrel can be knocked down and packed in crates or boxes to occupy very little space.

NEW BOOKS AND PUBLICATIONS.

THE GUNSMITH'S MANUAL. Messrs. Haney & Co., 10 Spruce Street, New York.

This is an illustrated volume of 375 pages, edited by Messrs. J. P. Stelle and W. B. Harrison. It is a volume of practical information for gunsmiths, and is calculated to be of interest and value also for sportsmen. It explains how their weapons are made, how they should be used, and how cared for when not in use. The manual is replete in useful information for gunsmiths and sportsmen.

INDUSTRIAL CYCLOPEDIA OF SIMPLE MECHANICS. By George E. Blakelee. Fords, Howard & Hulbert, New York.

The 700 pages of this book give plain, detailed directions for doing 2,000 common things. Its author is a practical mechanic, and was long an editor of a leading agricultural paper, so that he knows how to give his information in language devoid of abstruse terms, and so the "common people" will readily comprehend what is meant. It is not intended as a guide for professional workers in any special department, but to give valuable hints on "how to make and how to mend" to men, women, and children, indoors and out, as a daily aid in industrial affairs.

STATIONARY STEAM ENGINES FOR ELECTRIC LIGHTING PURPOSES By Robert H. Thurston. John Wiley & Sons, New York.

Some such book as this has been an evident want for quite a little time back, and Professor Thurston has kept sufficiently abreast with the progress of modern engineering to be eminently well qualified to do justice to his subject. The modifications in engine building which have taken place since electricity has been largely introduced are here concisely stated, and particular mention is made of the most conspicuous claimants for public favor in this field, showing what changes in construction and operation have been made, with the causes therefor.

Received.

THE CHILDREN OF THE BIBLE. By Fanny L. Armstrong, with introduction by Frances E. Willard. Fowler & Wells Co., New York.

THE PHYSICIAN'S VISITING LIST. A pocket memorandum book with blanks for each day of the year, with numerous handy references. P. Blakiston, Son & Co., Philadelphia.

Special.

THE EXPERIENCE OF AN EMINENT LECTURER.

The magic lantern, which was in former days only a toy, with its coarse and gaudy pictures for the amusement of uproarious children, has been improved and dignified by the introduction of photographic art. Competent scholarly gentlemen and finished speakers have done their part in elevating lantern picturings to their proper place in artistic education. The lantern and the lecturer now combine instruction with entertainment in graphically getting before the public illuminated evenings of travel among the wonders of our own country, or the antiquities and curiosities of foreign lands.

Prominent among the gentlemen who have dignified the lantern by bringing to its aid the triumphs of photography is Mr. Edward L. Wilson, of Philadelphia. A natural artist, a superior photographer, and a fascinating speaker, Mr. Wilson has attained a national reputation. In winter he addresses large city audiences, and in summer he gives his illustrated lectures at the various camps of moral and religous instruction throughout the country. His photographic establishment is known throughout the nation, and is enriched with many original works of photographic art taken by himself in his tour through foreign lands.

In consequence of his intense devotion to the duties of his profession, Mr. Wilson some years ago became a confirmed invalid. The labors which crowded him in connection with the photographing of the Centennial exhibits in 1876 first contributed to impair his naturally strong constitution. In these labors he had the constant charge of over one hundred artists and assistants, and was worked day and night beyond the reasonable capacity of even a very vigorous man. It is not surprising that his health gave way completely, nor that life became a burden hard to bear.

To one who called upon him a short time ago, Mr. Wilson told the story of his illness and his restoration.

"Run down?" he said. "Well, you may say so, when I tell you that the insurance men wouldn't touch me. I had policies in two of our best companies, and I wanted more insurance. Both of them refused me. And yet, one year afterward, one of them very gladly took a new risk on me, and the other was willing to. This was, of course, after I had fully recovered. Tell you how it was. The strain on me had been too great. *I ran down, down, down gradually.* Although I had an excellent constitution, and had lived a strictly temperate life, I was so much *prostrated that for a long time I could not sleep more than an hour or two in the course of a night. I suffered with acute neuralgia and with headaches, which, when they came on suddenly, would render me powerless to think or act.* My appetite became capricious, and I could eat only a small quantity of food at a time. My digestion was demoralized. *My throat gave me trouble, and I began to be afraid I had chronic bronchitis.*

"One day, five or six years ago, when I was suffering with one of my terrible headaches, a friend whose mother had been cured of rheumatism by the Compound Oxygen treatment said to me: 'Why don't you try oxygen?' I laughed at the idea, for I had no faith that such a thing could reach my case. Still I went to Starkey & Palen's office in Girard Street, and inquired into it. I took a few inhalations, and laughed at it again. But I saw that Doctors Starkey & Palen were fair and truthful gentlemen, and I determined to give their Compound Oxygen a very thorough trial. There was nothing unpleasant in it, and I had no fear that it would do me harm. In any event it could not make me worse than I was. I took the inhalations hopefully and faithfully. Soon, say in less than a month, I began to feel a great change for the better. My first symptom of improvement was that the headaches were less frequent, and by no means as painful as they had been. Then I began to get better sleep. That strained and wearied feeling of body departed, and with it the mental depression under which I had labored. When those frightful headaches were at their worst they would sometimes last all day. Now when they came, it would be hardly an hour from the first indications by buzzing in my ears and tingling in my finger tips, until the headache was over.

"Well, I might tell you a long story about it, but to be brief, *I recovered my health, throat trouble went away, and I had a decided increase of lung power. My good appetite returned as in former days.* My digestive organs became able to take care of all the food I gave them to dispose of. *In short, I was good as new.*

"*Most of this was accomplished in three or four months.* But as I had been so much run down, and wanted my restoration to be both complete and permanent, I continued the treatment for over a year, varying it from time to time in amount and method. At times I would omit it for several weeks, and then return to it again. It is about three years since I finished my regular course. Now I resort to it once in a while, in case I take cold or am subject to any extraordinary physical or mental strain.

"I went abroad in 1882, taking a protracted and somewhat laborious trip through Egypt, Arabia, and Palestine. I was beyond the ordinary conveniences of comfortable travel, and had to spend much of my time on camels and to do a great deal of walking and climbing. I found I could stand any amount of exposure. I could tramp the hills of Arabic Telvi, as easily as any of my three companions. So hearty and joyful was I that our old dragoman said to me 'You always make my heart glad when I am in trouble.' In all my tours abroad I had but two returns of severe headache; one at Mount Serval, the other at Cæsarea Philippi. I could eat anything that was set before me, and eat it freely.

"Since my return to this country I have engaged in my old duties with more than former activity. *I have lectured a great deal, and often in the open air, without any return of throat trouble.* I have attended without difficulty to the details of my large photographic business. I used to be susceptible to colds; having them, in fact, from November to May; one on top of another. Now I have had, as far as I can remember, only two colds in three years, though I have been fully subjected to every description of draughts. I enjoy my eating, and I sleep well. *It used to tire me to work my lanterns for an hour. Now I can easily do it for two hours without fatigue.* My weight is about the same as of old; say 135 pounds. *I can work, as a regular thing, about seventeen hours a day, and my work seldom tires me.*"

"I do not recommend Compound Oxygen for the man who wants to get well in such a hurry that he is not satisfied unless cured in twenty-four hours. But for those who have patience to try it faithfully, and to obey directions implicitly, I consider it the grandest vitalizer and restorer in existence. To my use of it I attribute my present state of good health. You may quote me as saying all that."

In these busy days of mercantile and professional activity there are thousands of overworked gentlemen who are as greatly run down as Mr. Wilson was. Their restoration may be as complete as his, if they will try a course of Compound Oxygen. To know all about this invaluable vitalizer and restorer, call on or address DRS. STARKEY & PALEN, 1109 and 1111 Girard Street, Philadelphia.

Business and Personal.

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Responsible partner wanted, with capital, to join inventors in manufacturing new Paper Folding Machines. Address office of *Wesleyan Methodist*, Syracuse, N. Y.

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Brush Electric Arc Lights and Storage Batteries. Twenty thousand Arc Lights already sold. Our largest machine gives 65 Arc Lights with 45 horse power. Our Storage Battery is the only practical one in the market. Brush Electric Co., Cleveland, O.

Practical Instruction in Steam Engineering, and situations furnished. Send for pamphlets. National Institute, 70 and 72 West 23d St., N. Y.

The Cyclone Steam Flue Cleaner on 30 days' trial to reliable parties. Crescent Mfg. Co., Cleveland, O.

For Steam and Power Pumping Machinery of Single and Duplex Pattern, embracing boiler feed, fire and low pressure pumps, independent condensing outfits, vacuum, hydraulic, artesian, and deep well pumps, air compressors, address Geo. F. Blake Mfg. Co., 41 Washington St., Boston; 97 Liberty St., N Y. Send for Catalogue.

Quinn's device for stopping leaks in boiler tubes. Address S. M. Co., South Newmarket, N. H.

Mills, Engines, and Boilers for all purposes and of every description. Send for circulars. Newell Universal Mill Co., 10 Barclay Street, N. Y.

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If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40. Various other foreign patents may also be obtained. For instructions address Munn & Co., SCIENTIFIC AMERICAN Patent agency, 361 Broadway, New York.

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Brass & Copper in sheets, wire & blanks. See ad., p. 222.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 20,000 Crank Shafts and 15,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

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A

Abattoir and stockyard of Pennsylv. R.R. ...*87
Abbey, Meirose ...*304
Abscess, Callender's method of treating by hyperdistension ...246
Absorption apparatus, Reiset's ...*259
Accumulator, Boettcher's ...*414
Accumulator, hydraulic, differential ...*230
Accumulators and piles at Munich Exhib. *414
Aceliograph, an apparatus for measuring the pressure developed by gun powder gases and for studying the laws of the recoil motion of fire-arms. ...*269
Acetate of soda manufacture ...234
Acid, sulphuric, tower for, Glover's ...*258
Acids, improvements in the manufacture of. 204
Acids see under proper titles, as citric, tartaric).
Acoustic repulsion, by V. Dvorak ...*139
Acoustics, an experiment in propagation and improvement of sound by the use of steel plates and wires, by A. C. English ...247
Acoustics in projection ...*253
Actinium, metal, by Dr. T. L. Phipson ...305
Actinometers, by Leon Warnerke ...*220
Adder, the ladder-back ...*337
Aerial echoes, by Prof. Joseph Henry ...153
Aerial locomotion, method, by C. Sarkady ...257
Aerial navigation, by Tim. Choinski ...*283
Aerial navigation, by F. Barnett ...372
Aerial navigation, by F. W. Brearey ...191
Aerial navigation, by Fred W. Brearey ...240
Aerial navigation, Montgolfier centenary. *406
Aerial ship, new, Dr. Woelfert's ...*400
Aerolitic epoch of November 12th, 13th, by Prof. Daniel Kirkwood ...128
Aeronautics, progress of, by Frederick W. Brearey. An interesting paper, containing brief accounts of the most recent trials of balloons having mechanical propelling attachments ...50
Affinity and valency, chem., by F. D. Brown. 310
Africa, Cameron's journey across ...10
Africa, Central, by Rev. John O. Mears, D.D. An interesting article, giving an immense amount of information in regard to that portion of Africa concerning which our knowledge is imperfect, describing the geological and physical formation of the country, its climate, products, inhabitants, and showing what is being done to open up this rich region to commerce. Illustrated with a map ...*208, *209
Africa, Commander Cameron's march across. * 72
Africa, equatorial, explorat., by De Brazza. *370
Agates, imitation, how to produce ...353
Age, influence of upon the intellect, an interesting and instructive paper ...246
Age of ice, evidences of, by H. Woodward ...*76
Aging distilled spirits, apparatus, Sweet's. 12
Agitator, mechanical, for use in Bessemer steel manufacture ...*316
Agricultural College, Ia, by Prof. Knapp. *189
Agricultural building at Centen. Exhibtion. *4
Agricultural Exper. Station, Rothamsted *101
Agricultural implements, ancient and modern, at the London Agricultural Show ...*189
Agricultural plant feeding, by E. Lewis Sturtevant, M.D. A paper showing the advantages to be gained by the use of certain chemicals in wheat growing ...150
Agricultural science, recent progress in, by H. P. Armsby ...269, 287, 345
Agriculture, chemistry of ...4
Agriculture, potash in ...132
Agriculture in Japan, notes on, from a lecture of President Clark ...161
Agouti, South American ...*38
Ailanto, or tree of Heaven ...*402
Aino cloth, fabrication of ...*244
Air and coal gas, explosive mixtures of 243, 245
Air and steam gauges, Nedden's ...*197
Air and steam, superheater and condens. for. *258
Air, anhydrous, as a therapeutic agent, by Dr. G. A. Keyworth ...200
Air and water. A lecture before a juvenile audidence, by John Tyndall, D.C.L. ...220
Air, atmospheric, oxygen from ...300
Airblast to sweep chimneys, Sylwaschy's. *351
Air, carbonic acid in, by M. Dumas ...358
Air, compressed, in mines, by M. G. Johnson 140
Air, compressed, for blasting ...188
Air, compressed, storage of, James' method. 282
Air compressor and rock drill, Ferroux's, by H. W. Pendred ...20
Air compressor, Dubois & Francois' ...*22
Air, gas and steam engine, comb'd Simon's. *168
Air, ground, in its hygienic relations, by Dr. M. Von Pettenkofer ...*82
Air compression, new method of ...*92
Air, compression of, by John Sturgeon ...*279
Air compressor, Cranston's ...*53
Air compressor, ventilating, Farcot's ...*390
Air compressor, Robey's ...*49
Air cushions for docks, Clark & Standfield's. *84
Air engines (see engines).
Air, heated, for combustion ...107
Air in relation to health, by C. F. Chandler. 362
Air moistening apparatus for spinning and weaving rooms, Koerting's ...*352
Air, motion of, effect upon the acoustic qualities of an audotorium, by W. W. Jacques ...164
Air passages, how they are explored, by F. Seeger, M.D. ...*108
Air pump, mercurial, simple, by G. M. Hopkins. Description of an easily constructed and inexpensive Sprengel & Geissler air pump which may be used for all purposes of experimentation, with figures showing construction ...*224
Air pump condenser, vertical ...*109
Air pump, mercur. double acting, Neesen's. *289
Air pump, duplex, Niagara ...*32
Air pump, Sprengel, Rood's modification of *303
Air pump, Wylie's ...*33
Air refrigerating machinery. *215, 252, *254, *274, *288, *320, 335
Air regulator for pump air-chambers ...*283
Air reservoirs for locomotives ...*197
Air temperature ...156
Air thermometers, by E. Rousseau ...*307
Air thermometers, new, by D. Winstanley *263
Air warming appliances, Boyle's ...*398
Alarm compass, electric, Severn's ...*195
Alarm, loom stopper, Demand's ...*90
Alarm, water gauge, Ledent's ...*245
Alaska, topography, climate, products, by Sheldon Jackson, D.D ...367
Album cover, by De Zuloaga ...*141
Albumen and gelatine, by A. P. Clark ...61
Albumen, commercial, by Alfred H. Allen 369
Albumen, convenient test for ...367
Albumen, test for, by Dr. W. H. Kesteren. 63
Albuminuria in persons apparently healthy, by John Munn, M.D ...228
Albuminoid substances, by M. Blennard. 325
Alcohol, a new method of detecting when used as an adulterant of the essential oils, by E. W. Davy, M.D ...95
Alcohol, effects of, by Rev. L. J. Templin. 355
Alcohol, caustic, mode of preparation and applications of, by Prof. A. B. Prescott ...163
Alcohol, conservation of tissue by, theory of, by Prof. E. Chenery ...295
Alcohol, deodorization of by electrolysis, Naudin & Schneider's process ...*343
Alcohol habit, effect of upon the human system. An interesting and valuable address by Dr. Wm. B. Carpenter ...367
Alcohol, how to strengthen ...186
Alcohol in nature. An account of the remarkable researches of M. Muntz, which led to the unexpected discovery that alcohol exists everywhere distributed throughout nature, in the earth, water, and atmosphere ...*288
Alcohol in the sick room, and its dangers, by J. D. Crothers, M.D. Clinical studies of the histories and early causes of many cases of inebriety, with medical testimony and remarks on several remedies having alcohol as a base. 142
Alcohol, insanity from, by Dr. A. Baer ...415
Alcohol, chemical test for, by Dr. E. W. Ray. 46
Alcohol, method of strengthening ...186
Alcohol, oxidation of ...271
Alcohol, rectification of by electricity, Naudin's system of ...*415
Alcohol, solidification of ...386
Alcoholism in its relation to life insurance. 125
Alcohols, distillation and rectification of by use of low temperatures, by Raoul Pictet ...*299
Alcohols, impure, rectification and disinfection of by the methods of L. Naudin, R. Pictet, and Eiseman, by A. Schlumberger ...328
Alders for the lawn, advantages of ...236
Aleurometer, or flour tester ...*99
Aleutian Isles, contribution to the history of, by Dr. Arthur B. Stout ...296
Alexandria, bombardment of by the English, July, 1882 ...*343
Algin, a new substance obtained from common species of marine algæ, its mode of preparation and its applications, by E. C. C. Stanford ...396
Algol, the demon star ...411
Alimentation, artificial, the different methods of, by Dr. Thos. J. Gallaher. A paper on the different methods of administering food aside from the voluntary method by the mouth ...194
Alimentation, forced, a paper by Alexander Hutchins, M.D. ...222
Alizarine, artificial, how to dye red with, by M. Prud'homme ...286
Alizarine from anthracen-sulpho-acid, by G. Auerbach ...3
Alizarine and allied coloring matters, the history of, and their production from coal tar, by W. H. Perkin, F.R.S. A very valuable technical paper, giving an exhaustive account of the alizarine industry ...186, *187
Alizarine blue, in dyeing and printing ...160
Alizarine, by J. R. Johnson ...134
Alkalimetry, by J. Chisholm ...65
Alkalimetry, indicators for, a critical examination of those now in use, by E. J. Hallock ...325
Alkaloids, constitution of, recent studies on, by Dr. S. P. Sadtler ...415
Alkaloids, mydriatic, by A. Ladenberg ...324
Alkaloids, new color reactions of with certain reagents, by B. Arnold ...397
Alkaloids, vegetable, reagents, by R. Paim. 403
Alligator, Florida ...165
Alloy, metallic, new, Parsons' ...49
Alloy, white metal, improved, recipe for ...39
Alloys, anti-incrustation, by O. Holden. 30
Alloys, copper, among the ancients, by Prof. E. Reyer ...404
Alloys, metallic, method of imparting resonance to, by B. Silliman ...12
Alloys of lead and antimony, eliquation. 227
Alloys of silver with embrittling metals, experiments on, by A. E. Outerbridge, Jr ...185
Alloys, wolfram, practical value of ...153
Alphabet acrobatic. An ornamental alphabet of which the different letters are derived from the human figure in various attitudes. Useful to all letterers and ornamenters ...*305
Alphabets, the world's; a series of engravings displaying all the modes of writing employed by man ever since he learned to express ideas. *35
Alum, manufacture of by Spence's process... 89
Alum in flour and bread, improved process for the detection of, by A. W. Blyeth ...329
Alum in Wyoming Territory ...3
Alum solutions, how to ascertain the density. 77
Alumina, fixation of, as a discharge on indigo blue by aluminum chloride, by G. Saget ...336
Alumina salts, effect of on the gastric juice in the process of digestion; experiments on twenty-two living animals, by Henry A. Mott, Jr. ...214
Aluminum and its alloys, new process for, Niewerth's ...411
Aluminum, industrial uses of ...35
Aluminum industry, present status of ...192
Aluminum, manufacture of, new process, Thompson's ...245
Aluminum, method of manufacture, characteristics and applications of ...50
Aluminum, its properties, cost, and uses. ...362
Amalgamation, battery and copper-plate, by Prof. R. H. Richards ...346
Amalgams, dental, an exhaustive paper upon, by Dr. Charles J. Essig ...183
Amateur mechanics (see mechanics).
Amber, concerning, by Erminnie A. Smith. An interesting and exhaustive paper ...*226
American progress, comparative view of, by R. P. Porter. An interesting paper. ...207, 208
Amethyst, purple color, cause of ...351
Ammonia, apparatus for manufacturing, Lorenzen's ...*284
Ammonia, carbonate, from gas liquor, apparatus to manufacture ...*170
Ammonia, a new continuous process of making, by Dr. Gruneberg ...*281
Ammonia engine, Gamgee's ...*281
Ammonia, determination of by hypobromite of sodium, apparatus for, Francis' ...*79
Ammonia, distrib. of, by Dr. R. A. Smith ..142
Ammonia from gas liquors, apparatus for extracting, Elwert & Muller-Pack's ...*296
Ammonia, formation of a chemical compound of, with silver bromide, by J. V. Eidsen. ...*285
Ammonia, intravenous injection of, as a means of stimulation, by Gaspar Griswold, M.D. ...187
Ammonia, laws of exchange of between the sea, atmosphere, and continents, by Th. Schloesing. 1
Ammonia, liquid, apparatus to test ...*393
Ammonia, manufacture of by means of the nitrogen of the air; Rickman's process. ...*254
Ammonia salts, manufact. from gas liquor *187
Ammonia, synthesis of ...296
Ammonia soda process ...171
Ammonia water concentrator, Solvay's ...*249
Ammonia water, production of, apparatus *357
Ammoniac, from leather rubbish, manuf. *258
Ammoniacal liquor, apparatus for distilling, Feldmann's ...*416
Ammoniacal waters, treatment of, Hennebutte's process ...330
Ammonium sulphocyanide, application of in volumetric analyses ...119
Ammonium, chemical properties, compounds, and tests of ...302
Amperemeter and voltmeter, Deprez and Carpentier's ...*353
Amperemeter, solenoid, Blyth's ...*389
Amphitheater, and forum, Roman, at Arles, France ...*375
Amyl nitrite, medical uses of ...299
Amyl nitrite, hypodermic use of, by Dr. J. J. F. Barnes ...349
Anaconda at Zoological Gardens, London. *73
Annealing metals, electricity for ...*9
Analogy between the conductivity for heat and the induction balance effect of copper-tin alloys, by W. Chandler Roberts, F.R.S. ...*210
Analyses, quantitative, color comparator for, by Prof. A. R. Leeds ...*134
Analyses, volumetric, application of ammonium sulphocyanide in, by J. Volhard ...119
Analysis, chemical, precipitates in, new method of separating and treating, by F.A.Gooch. *130
Analysis, general method of, for the tissues of vegetables, by E. Fremy ...61
Analysis, hop, principles of, by C. O. Cech. 303
Analysis, quantitative, a new method of extensive applicability, by Prof. A. Classen ...205
Analysis, spectrum, by Prof. Redwood ...79
Analysis, spectrum, applied to the solar system, by W. Huggins ...281
Analysis, volumetric, in photography, appliances for ...112
Anatomy, pathological, the role of, by Prof. J. Cohnheim ...201, 203
Anæsthesia, a new discoverer of ...81
Anæsthesia under pressure, Bert's exper. ...202
Anæsthetic, new, bromide of ethyl, by R. J. Levis, M.D. ...218
Anchor, sea, Bullivant's ...*355
Anchor, ship's, improved, Tyzack's ...*81
Anchor, two ton, Smith's ...*279
Anchors, portable, Capt. Swinburn's ...*93
Anemograph, Howlett's ...*236
Anemograph, Montsouris ...*198
Anemometer of Mt. Santis observatory. *416
Anemometer, Robinson's ...*7
Angle block, Howe truss, dimensions, method of calculating ...*98
Aniline black, cerium, preparation ...182
Aniline black, dyeing with vanadium ...245
Aniline black, electrolyt., by F. Goppelsoder. 15
Aniline black, theory of the production of by the salts of vanadium, by A. Guyard ...15
Aniline black, improvements in, by A. Guyard. 69
Aniline, mode of preparation ...*178
Aniline colors at the Centennial Exhibition, with brief notes on the mode of manufacture of the different colors, by Carl Rumpff ...32
Aniline printing, process for ...343
Animal and plant life, abstract from lecture by A. R. Grote, A.M. ...*179, *185
Animal colors, the philosophy of, by Dr. Andrew Wilson ...328, 329
Animal intelligence, abstract of lecture by G. J. Romanes ...145
Animal intelligence, by C. Lloyd Morgan. ...361
Animal life, by Dr. J. H. Barker. Terrestrial life not a distinct entity, but a temporary condition of certain peculiar kinds of matter ...273
Animal motion, discoveries of the past half century, by Dr. J. Burdon-Sanderson ...310
Animals and plants, varying susceptibility of, to poisons and diseases ...303
Animals and plants, protective mimicry in, by Prof. Mivart ...254
Animals, chlorophyl, researches on ...324
Animals containing chlorophyl ...181
Animals, domestic, diseases, by Prof. Law. 243
Animals, domestic, the disposition of color markings in, by Prof. Wm. H. Brewer ...297
Animals, extinct, discoveries in the Rocky Mountains, resume of, by Prof. Marsh ...34
Animals, fur-bearing of Maine ...316
Animals, hibernation of ...324
Animals, how they became carnivorous, by T. R. Allinson ...349
Animals in motion, attitudes of, by Mr. Muybridge ...343
Animals of the deep sea, abstract of an interesting paper on deep sea fauna, by Dr. Pagenstecker ...261
Animals, phosphorescent; facts and thoughts, by Prof. P. Martin Duncan, F.R.S ...*197
Animals, reasoning of, by Jos. F. James. ...298
Animals, sex in, how to control ...211
Animals, speech in ...372
Animals, the earlier migrations of, and their relation to the present distribution of animals. An important contribution to our knowledge of existing animal life, by Carl Vogt ...262
Animals, uses of in the ornamental arts. ...362
Animals, vaccination of, by L. Pasteur. ...300
Animals, winter sleep of ...372
Animation, suspended. A paper by B. W. Richardson, pointing out what, by experiment, is known as to the possibility of suspending animal life by different agents ...185
Annular wheels, forms of epicycloidal and involute teeth for inside gear, failure of the odontograph in certain practical cases, by Prof. C. W. MacCord ...*201
Annular wheels, machine for cutting, De Junker & Ruh's ...*365
Anthracene ...180
Anthracene, apparatus to manufacture. *187
Anthracite coke as a steam fuel ...47
Anthrax, etiology of, by L. Pasteur ...259
Anthropology, twenty years progress in. Abstract of an address by Prof. Huxley. ...148
Anthropometrical measurements ...190
Anti-fat remedy ...366
Antiquity of man in Eastern America geologically considered, by H. C. Lewis ...258
Antiseptic compound, new, application of, to preservation of food, by Prof. Barff. ...332
Antiseptic substances, qualities of various. 389
Antiseptics, albuminated ferrous borotartrate. —Camphorated chloride of calcium, by Carlo Pavesi ...337
Antiseptics, relative power of ...332
Antiquities, Central American, recently discovered ...*289
Antiquities, Egyptian, of the Boulak Museum, by R. L. N. Michell ...36
Ants as grub destroyers in China, by Dr. Macgowan ...336
Ants, intelligence of, by Sir John Lubbock. 143
Ants, white, or termites ...*223
Ants, Sir John Lubbock on ...178, 241
Antwerp, port of ...246
Apatite, Canadian ...387
Apes, nose ...*389
Appearances vs. realities ...116
Apiculture, practical, by Prof. A. J. Cook. 246
Apiculture, relation of to science, by A. J. Cook ...276
Apoplectics, their mental state, their degree of responsibility, and their civil capacity, by Legrand Du Saulle ...321
Apoplexy, popular errors as to the nature of. 2
Apple blossoms ...*115
Apple coring machine, how to make ...*313
Apple jelly, how manufactured ...360
Apple-tree borer, remedy against ...167
Apples, storing of, by J. S. Woodward ...358
Apples, American, the most approved kinds. 287
Apples, American, in Europe ...218
Apples, how to gather and store ...304
Apples, how to preserve ...209, 210
Aquarium and winter garden, Plymouth *149
Aquarium, great, at Birmingham, Eng., by William Alford Lloyd ...189
Aquarium, Royal, London, description of the building and its arrangement, with illustrations of the hydraulic machinery employed ...*14
Aqueduct of lead pipe, cheap and successful, by Prof. R. Fletcher ...266
Aqueous vapor, influence of on the explosion of carbonic oxide and oxygen, by H. B. Dixon. 358
Aqueducts of Paris, Roman ...*291
Aqueducts, Roman, ancient ...*20
Arago, Francois. Biographical sketch, with illustration of statue erected to his memory at Perpignan ...*204
Arboriculture, ornamental, a practical paper upon, with a list of trees suited for ornamental plantations in the Northern United States, by John Robinson ...352
Archæological explorations, Asia Minor. ...313
Archæological explorations in Ohio. An account of explorations made near Madisonville, O., in 1878, 1879, and 1880, the results of which are the most interesting of any that have hitherto been conducted in the Mississippi Valley, with descriptions and forty illustrative figures of a large number of aboriginal relics ...*282
Archæology, American, Smithsonian Institution, inquiries concerning ...131
Arches and tunnels, beton ...*227
Arches, masonry, cause of failure of ...42
Architect, fire engineers and underwriters. 250
Architecture, American, English ideas of. 370
Architecture, cast iron in ...324
Architecture, color in, by G. Aitchison. ...381
Architecture, Italian and French ...*113
Architecture in the U. S., prospects of ...11
Architecture in Cairo, Egypt ...*382
Architecture, marine, the Bucentaur ...*62
Architecture of Chicago ...118
Architecture, Roman, ancient, at Hydra. *323
Architectural profession, the prospects and position of, by John McLachlan ...268
Arctic exploration, by B. Leigh Smith. ...*356
Arctic exploration, Nordenskjold's expedition. Successful northeast passage of the Vega, with portraits of Prof. Nordenskjold and Capt. Palander ...*231, *232
Arctic explorations, cruise of the Jeannette, with portrait of Lt. De Long ...*320
Arctic exploration, loss of the Jeannette. *339
Arctic explor., Nordenskjold, N.E. passage. 211
Arctic explorations, recent, Nordenskjold's. *158
Areothermic balance for determining the density of fluids, Blondeau's ...*237
Argand, Fletcher's, for titration ...*323
Armadillo, truncated ...*241
Armature, stepwound, Crompton's ...*375
Armenia, antiquities from ...112
Armitage House, near Manchester ...*362
Armor plate, approximate rules for the penetration of ...272
Armor plate, chilled cast iron, for batteries, advantages of, with description of chilled iron cupolas built for the Prussian Government, and of the St. Marie battery at Antwerp ...*215
Armor plate, trial of competitive shot against. *127
Armor plated forts, experimental firing at with great guns, England ...*406
Armor plates, compound ...109
Armor plates, compound, Wilson's ...*113
Armor plates, steel ...112
Army and navy building, Washington ...*307
Army bed, desk, and knapsack, combined. *369
Army worm, its life history, its habits, and the mode of exterminating it ...*306
Arsenal, Austrian Lloyds' at Trieste ...*239
Arsenic in the arts as a cause of arsenical poisoning, by S. A. Lattimore, LL.D. An important paper ...29
Arsenical wall paper and artificial flowers, dangers of ...272
Art manufactures of Japan, by Dr. Christopher Dresser. An interesting paper, describing the methods of making pottery and fans, and processes of weaving, silk decoration, and lacquering, etc. ...115
Art gallery of the Centennial Exhibition ...*2
Art gallery, Walker, Liverpool ...*96

Artesian wells. A comprehensive and valuable paper, giving an account of the most recent borings in San Francisco and of the tools there employed, and particulars of artesian wells in other parts of the country, the tools used, the cost, etc *156, 157, *158, *159, *160
Artesian wells and the great Sahara, by Lt. Schroeder 215
Artesian wells in Sahara, by P. De Tchihatchef. 353
Artillery experiments in England *59
Artillery experiments at Spezia with one hundred ton Armstrong gun *374
Artillery, progress of 140
Artillery system, Col. Bange's *426
Artisans' dwellings *420
Artisans, skilled, necessity for more, by James M. Blanchard 19
Artists' homes. A series of views and plans illustrating the dwelling houses of the leading painters, architects, and sculptors of England, accompanied with descriptions thereof. *231, *235, *238, *240, *247, *248, *259, *261, *267, *270, 275, *299, *312
Arum family, Caila and other lilies *424
Asbestos and its varieties 342
Asbestos and its various applications in the arts and industries *396
Asbestos stopper for combustion tubes 287
Asia, the central plateau of. An interesting review of all that is known concerning this district, by Sir R. Temple 361
Ash tree and its varieties *361
Ashes as plant food 68
Asparagus, cultivation, French system *370
Aspergillus in the living human ear, by C. H. Burnett, M.D *208
Asphalt, its origin, preparation, and uses. A valuable article 396
Asphaltum, its geological origin, preparation, and applications *276
Asphalt for photographic purposes 243
Asphalt pavements in Washington, mode of laying, wear, cost for repairs, etc 334
Asphalt, prepara., tests, directions for use 122
Asphaltum, nature and composition of 216
Asphyxia, a speedy method of obviating in the infant, and also for the relief of that condition in the adult, by H. L. Byrd, M.D *215
Aspirator, improved, Richard's *51
Assay office, some problems arising in, by C. H. Aaron 305
Assyria, archæological discoveries in 302
Assyrian discoveries, recent *157
Asteroids, distribution, by D. Kirkwood 28
Asteroids, by Prof. C. A. Young 77
Asthma and hay fever, treatment of, by Alonzo Clark, M.D., LL.D. A valuable paper 221
Asthma, bronchial, remedies for, by Dr. Jno. C. Thorowgood 171
Asthma, grindelia robusta as a remedy for, by Dr. T. M. Rochester 285
Asthma, iodide of potassium in 123
Astigmatism *139
Astigmatism; a paper by Dr. C. A. Bucklin, showing how this affection is to be diagnosed and corrected. Illustrated with a diagram to be used as a standard for testing distant vision *301
Astigmatism and ophthalmometry, by M. Gavarret *383
Astigmatism, instrument for estimating, Anderson's *253
Astringent substances, new process of titrating, by F. Jean 59
Astringents, comparative value and strength 25
Astronomical photography. Abstract of a lecture by Prof. J. K. Rees 335
Astronomical science, present condition of, an address before the American Association, Boston, by Asaph Hall 247
Astronomical time, instrument for marking, Horn's *13
Athens, American school of classics at 416
Athens, antiquities of, 12 engravings *421
Atmograph register, Montsouris *198
Atmosphere and ozone, by Prof. A. R. Leeds. A valuable paper *154
Atmosphere, carbonic acid in, Reiset's investigations concerning *259
Atmosphere, disinfection of, abstract of lecture by Dr. R. J. Lee 417
Atmosphere, infective, a combat with, by John Tyndall. Facts tending to disprove the theory of spontaneous generation 65
Atmosphere, celestial bodies, Landeur 258
Atmosphere of stove heated rooms, by W. M. Williams 323
Atmosphere, the removal of aqueous vapor from, by J. J. Coleman 281
Atmospheric hammer, Butterfield's *44
Atomizer, Lochmann's *340
Atoms, attractive force, by D. P. Blackstone. 75
Atoms, molecules, and ether waves, by John Tyndall, F.R.S. 365
Aural therapeutics, a clinical lecture, by Dr. Laurence Turnbull 193
Aurora borealis and telegraph cables 288
Auroras, a new theory of *30
Auroras, polar, cosmic, optic, magnetic, and electric theories of, with illustrations of some remarkable forms *372
Australia, gold-bearing rocks of 371
Australia, its desert, and natural history 139
Audiometer, Prof. Hughes' 186
Automata, performing, remarkable *156
Aveling, Thomas, the father of traction engines Biographical sketch and portrait *331
Axle boxes, radial, railway, improved, by H. W. Widmark *117
Axle breakage on railways, by W. Thamm *76
Axle, car and tender, standard *294
Axle cranks, locomotive, apparatus to square and measure *284
Axles, moving, speed and torsion of, telephonic indicator for, by C. Resio 343
Axles, railway, friction of, experiments on 191
Ayrton, Prof. W. E. Sketch and portrait *335
Aztec ruins of Southwestern Colorado, on the Rivers La Plata and San Juan *92
Aztec ruins in Colorado *244
Aztec ruins in New Mexico *226

B

Babirousa, the *415
Baboons, South African *205
Babylonia, recent discoveries in 316
Bacteria as a cause of disease, Dr. S. H. Potter. 3
Bacteria as a cause of disease in plants, by Prof. T. J. Burrill *297
Bacteria in the soil and air 375
Bacteria investigation, progress of. An interesting summary of recent observations and theories, by G. Marpmann *304
Bacteria, transformation of, a new theory 334
Bags, paper, machines for making *191
Balance, æreothermic, for determining the density of liquids, Blondeau's *237
Balance, barometric, Redier's *254
Balance, dispensing, tubular, Gorman's *292
Balance, electro-dynamic, Debrun's *355
Balance, hydrostatic, Wackermann's *224
Balance, magnetic, Brunner's *386
Balancing of machinery; practical information deduced from special experiments at Defiance Machine Works. A valuable paper. *368
Balawat, bronze gates of 201
Balcony railing and inclosure for Goethe monument, Berlin *287
Baldness, pilocarpine for 231
Baldness, premature, cause of and treatment, by O. Lassar 416
Baldness, remedies for and proper treatment of the hair, by Dr. John V. Shoemaker 173
Baldness, treatment of, by Dr. G. H. Rohe 161
Balfour, Prof. F. M. Sketch, portrait *356
Ball puzzle experiment, a simple method of performing *51
Ball suspension puzzle at the Centen. *37, *47
Ballast, water, for ships, by Benj. Martel *97
Balloon, captive, at the Paris Exhibition. *146
Balloon, electric, Tissandier's. Full description of the construction of the balloon, and of the propelling apparatus and batteries *416
Balloon, Giffard's, details of construct'n. *127
Balloon, Giffard's, at the French Exhib *46
Balloon musket, Krupp's *40
Balloon, new, Woelfert's *400
Balloon, the great captive, end of the *203
Balloons, buoyancy of, regulation, by E. C. Omhart 312
Balloons, India rubber, how made 249
Balloons, manufacture of, at Paris *413
Balloons, steam engine for *286
Ballooning from England to France *330
Ballooning, military. Abstract of a paper by Lt. B. B. Powell, on the various uses for which the balloon may be used in warfare 397
Balls, suspension of on jets of air, steam, or water, by W. F. Durfee, C.E *76
Balsam fir tree, by C. H. Peck 264
Bamboo, acclimation of in the U. S. 372
Bamboo, use of in China, and the advisability of cultivating it in the United States 290
Band saw for iron, improved *397
Band saw, sharpening and setting mach. *331
Bank checks, safety, Nesbit's 271
Baptistery, design for *220
Barge, State, of University College *243
Barks of the oak, willow, and eim, chemistry of, by E. Johansen 87
Barley, maize, and rice, chemical comp 87
Barley, maize and rice, chemical composition of, by J. Steiner, F.C.S. 288
Barn, octagon, how to construct; full particulars, with plan of basement *13
Barometer, absolute, Haus & Hermary's. *195
Barometer, Dufuor's new registering *420
Barometer, dynamic, Winkler's *207
Barometer, how to make, by A. F. Miller. *309
Barometer, mercurial, record'g, Draper's *209
Barometer, mirror, De Bort's *179
Barometer, registering, Cecci's *198
Barometer, registering, Redier's *36
Barometer, registering, Richard's *379
Barometer, the Jordan 272
Barometers, improved, Wagner's *51
Barometric balance, Redier's *254
Barometrical high and low pressures caused by gyrating winds, by G. W. Dow *99
Barrel lifter, German *46
Barrel making machinery, Holmes' *36
Barrels, improvement in the manufacture of, by R. M. Munroe *82
Barrels, method of charring the interior of, by W. McMurtrie *68
Baseball base, O'Neill's *10
Baseball science. A paper showing how balls are thrown so as to make a curved path, and why they follow a curve *402, *410
Baseball, improved, Hipkins' *12
Basket, drop, or bag-worm, by Prof. C. V. Riley *143, *152
Bassic mine, Colorado *214
Baths, swimming, Chelsea *85
Bats, protective mimicry in 72
Bathyblus, what is a? 71
Bathing, prolonged, physiological effects. 323
Bathometer, deep sea sounding, Siemens' *23
Battery and telephone, breath, Harrison's. *160
Battery, Bunsen, improved, Azapis' 264
Battery, Callaud, low resistance 409
Battery, Callaud, economical arrangement. 167
Battery, carbon, plastic, how to make 415
Battery, cascade, for tel. purposes, Higgins' *363
Battery cell, Daniell, as a standard of electromotive force, Moser's 295
Battery cell, Plush's *173
Battery cell, an improved *367
Battery cell, voltaic, new, Biggs' 48
Battery, chemical work produced by, by D. Tommasi 347
Battery, chloride of lime, Niaudet's *219
Battery, chloride of silver, De la Rue's *115
Battery, chloride of silver, Scrivanow's *385
Battery for electric balloons *416
Battery, galvanic, improved, Fuller's *40
Battery, galvanic, Watson's *33
Battery, electric, of flames 351
Battery, insulite, sealed *390
Battery, Leclanche, new form of 191, 203
Battery, light, new, for railway trains 417
Battery, manganese, improved, Leuch's 392
Battery, manganese, Rousse's 313
Battery, mercury, bichromate, Fuller's *71
Battery, new 171
Battery, new, Camacho's *47
Battery, new, Gaiffe's 171
Battery, new oxide of copper *421
Battery, new, Pulvermacher's 139
Battery, nickel, Slater's *210
Battery, ozonizing, Leeds' *203
Battery, Plante, modification of, Pezzer's 301
Battery, Pezzer-Plante *323
Battery, Reynier-Plante, accumulator *426
Battery, Schultze's *414
Battery, secondary, Faure's, by C. A. Faure. 304
Battery, secondary, Liardet-Donnithome 370
Battery, secondary, Sellon & Volckmann 332
Battery, sesquioxide of iron and chlorhydrate of ammonia, Gaiffe's *9
Battery, storage, electric lighting of the Comptoir d'Escompte by *354
Battery, storage, electrical, by H. Sutton 322
Battery, storage, Houston & Thomson's *215
Battery, thermo-electric, Clamond's *211
Battery, thermo-electric, Sudre's *195
Battery, voltaic, a cheap form of, by Alfred R. Bennett 326
Batteries, bichro. soda, Jarriant & Grenet's *354
Batteries, electric, earth, Cerbaux's *42
Batteries, galvanic *157, *158, *159
Batteries, galvanic, descriptions of several improved forms—Slater's, Howell's, McCarty's, Egstrom's, and Gutensohn's 238
Batteries, secondary 346
Batteries, secondary, Plante's, by A. Niaudet-Breguet *5
Batteries, secondary, and the electrical storage of energy, two valuable lectures delivered before the Society of Arts by Prof. O. Lodge 416
Batteries, secondary, by Prof. O. J. Lodge. 342
Batteries, secondary, Grove's, Plante's, and Faure's, by Prof. W. Grylls Adams. A valuable statement of the construction, operation, efficiency, and utility of these new reservoirs of electrical energy 314
Batteries, secondary, Rousse's 312
Batteries, secondary, with special reference to local action, by Dr. J. H. Gladstone, F.R.S. 357
Batteries, nitric and chromic acid, by John T. Sprague 381
Batteries, storage, Edison's views on 376
Bay tree, California, ethereal oil of, by J. M. Stillman 235
Beacon tower of Lavezzi, the *169
Beam compasses for draughtsmen, new *20
Beams, compacted, by Thomas Morris *117
Beams, curved *128
Beams, flexure of, experiments on 17
Beams, theory of strength, how to estimate the load upon a floor beam 127
Bean, microscopic study of, by L. R. Stowell. *246
Bean, soy *362
Beans, cultivation of 174
Beans, devil, of Mexico *106
Bear, polar, by Capt. Koldewey 9
Bearings and brasses, heating and cutting in, some of the causes of, by Joshua Rose *3
Becquerel, Antoine Cæsar. Biographical sketch, with portrait *259
Becquerel, Regnault, and Secchi. A sketch of their lives and labors, with portrait of P. Secchi *120
Beehive, an ancient *93
Bee culture, by A. J. King 153, 154
Bee exhibition, British 144
Bee keeping in India 411
Bee, new enemy of, by Prof. A. J. Cook 417
Bee, the queen, with especial reference to the fertilization of her eggs, by John Hunter 179
Bees, most profitable kinds to keep 135
Bees, by F. Smith 143
Bees, how to prepare for winter 199
Bees, how to hive swarms of, in high trees. *38
Bees, transferring, hints on 118
Bees, queen, Italian, the proper season for introducing 49
Beeswax, white, method of testing for ceresine and paraffine, by A. Peltz 315
Beef, American, for English markets, process of killing 153
Beef blood powder, value of, for invalids 407
Beer, apparatus for preserving, Weinmen's *4
Beer, apparatus for reviving *267
Beer casks, new, how to sweeten 256
Beer, condensed, by Dr. Bartlett 12
Beer, ginger, lemon, hop, etc., recipes for 270
Beer, hop-resin and other substances in 220
Beer, how to make lager beer; how to make "Schenk" beer; how to make "Bock" beer; full and practical directions for making beer at home 318
Beer, lager, how to make 217
Beer, milk, how to make 218
Beer, organisms found in. A valuable paper by E. C. Hansen *237
Beer, drawing, pressure apparatus for *346
Beer, racking device to retain carbonic acid in, Seibel's *401
Beer, recipe for making 147
Beer, ropiness in, cause and treatment of 195
Beetle, scolytid, ravages of, among maples. *388
Beetles that prey on hollyhocks.—The parsnip-seed moth.—The current-bud mite *369
Beet pulp, continuous press for, Dujardin's *351
Beet root and beet root sugar, by Edw. Lefroy Cull. Description of a process of beet root sugar extraction for farmers' use 83
Beet root molasses residue, apparatus for distilling and carbonizing *376
Beet root sugar, strontia process for 408
Beet sugar industry. A plea for its extension in the United States, by Ernest T. Gennert 166
Beet sugar in France and Germany, by John Sparrow 186
Beets, new products from 181
Behring's Straits currents 286
Bell 29
Bell, "Great Paul," St. Paul's Cathedral. *340
Belfry of Crescentino, removal of *417
Bells, church, new mode of mounting 204
Bells, electro magnetic, useful, as calls on telephone or telegraph lines, with working drawings and full directions how to make *162
Bellows, foot, improved *87
Belts, adhesion of, by J. H. Cooper 236
Belts, leather, horse-power of, formula and tables for 331
Belts, rubber, how made 251
Belts, transmitting, chain, Bushnell's *6
Belting, rules for calculating the power of. *39
Bending roller for boiler plates, Beesley's. *324
Bending rolls, boiler-plate, improved *302
Bending machine for angle iron, Bennie's. 327
Bengal lights, recipes for 49
Berth, swinging, for ships, Andrews' *8
Bessemer, Sir Henry. An interesting account of his life and inventions 244
Beton, concrete, in building *118
Beton tunnels and arches: a paper describing the recent successful application of beton to the lining of railway tunnels where stone and bricks are inapplicable *227
Bevel gear cutter, Corliss *50
Bevel gear wheel cutter, Corliss, by J. Rose. *24
Bevel wheels, ellipt., by Prof. C. W. MacCord *141
Beveling circular plates, machine for, Pedder & Abel's *45
Beverages, summer, forty choice recipes. A valuable paper 192
Beverages, gaseous, apparatus for manufacturing, Mondollot's *365
Bianconi, Charles, the inventor of the Irish car. Biographical sketch 116
Bicycle, Columbia *163
Bicycle, double, English *318
Bicycle and tricycle, the Merlin *334
Bicycle, large wheeled, new *54
Bicycles, by Paddiefast *73
Bicycles, improved, Garrood's *99
Bicycles, improvements in, Turner's *126
Big trees (Sequoiæ) of California *397, *404
Bile, secretion of, action of drugs on 203
Bilious diseases, what they are and why so called, by I. H. Nowlin, M.D 152
Binary arithmetic, experiments in *421
Binding of a book of songs, the former property of Henry and Diana of Poitiers *405
Biology and chemistry, borderland of 289
Biological sciences, connection of with medicine, by Prof. Huxley 300
Bird architecture, the phipidura *228
Bird, fossil, from Colorado *149
Bird flight, the mechanics of 271
Birds, toothed, of Kansas 258
Birds, are they derived from dinosaurs, by Prof. B. F. Mudge 193
Birds, migrations of, by H. D. Minot 310
Birds, the flight of, and the mechanical principles involved. A paper by A. C. Campbell, showing how the bird manages to sustain itself against gravity, and to acquire any desired speed. *298
Bismuth bronze, how made 398
Bismuth, comparison of the methods for its estimation, by T. B. Stillman 124
Bismuth oxide, as an agent for opening up silicates, by W. Hempel 336
Bitumen of Trinidad 174, 175
Bjerknes' experiments in reproducing the effects of electricity by vibrations *315
Blackberries 300
Blackberry, Kittatinery, by E. Williams 121
Bladder, minute fragments of stone in, a new searcher for detecting, by Edmund Andrews, M.D *152
Blanchard, Madame Sophie, the celebrated aeronaut. Biograph. sketch and portrait *195
Blast furnace, anthracite, Weimer's *101
Blast furnace, apparatus for charging, Weimer & Birkenbine's *13
Blast furnace slag, fluid, improvements in the treatment of, by A. D. Elbers 295
Blast or vacuum apparatus, laboratory, Hanks' *7
Blast furnaces of Great Britain 18
Blast furnaces of Bethlehem, Pa., Iron Works *93
Blast furnaces, process of applying oxygenated air in, Hombostel's 83
Blast furnaces, substitution in of liquid vaporized and gaseous hydrocarbons for solid fuel, by C. Piagge *3
Blasting and blown out shots in fiery mines, by W. Purdy *256
Blasting by compressed air, by W. E. Garforth. 188
Blasting compound, new, Huetter's 176
Blasting explosives, modern 127
Blasting, how to make the hole, what explosives to use, how to fire the charge, by Arthur Kirk 270
Blasting h les made by means of hydrochloric acid 211
Blasting, lime cartridges for 416
Blasting, submarine, experiments in *74
Blasting, submarine, Lauer system of *342
Blasting without powder 62
Bleaching apparatus, Morris' *373
Bleaching and dyeing straw hats, various recipes for 277
Bleaching by electricity *410
Bleaching kier, improved, Bracewell's *205
Bleaching of vegetable textile materials, application of electricity to *401
Bleaching process for ostrich feathers 192
Bleaching textiles, process of 147, 153
Bleaching wool, Knab & Fournier's method. 135
Bleaching wool without stoving 89
Bleaching wool without sulphur 149
Bleaching woolen goods, process of *137
Block building, Z system of *203
Block, cargo, Laurence's *253
Blood corpuscles, contraction of through the action of cold, by R. U. Piper, M.D *68, *69
Blood corpuscles, decolorized, and their identity with tuberculous corpuscles, by Dr. Rollin R. Gregg 190
Blood corpuscles of animals, relative sizes .. 28
Blood corpuscles, red, by W. H. Hammond. *98
Blood, circulation of, by Th. Moureau *184
Blood, circulation of, by Prof. E. J Marey *212
Blood, peroxide of hydrogen in, an attempt to explain the curative action of certain remedies in general use, by John Day, M.D 155
Blood pressure, apparatus to measure *184
Blood stains, easy methods of detecting, by Prof. D. S. Kellicott 261
Blossom Rock, San Francisco harbor, method employed in removing *24
Blotting paper, how made 17
Blow, duration of; how it varies with the weight of the hammer, its velocity of descent, and with the material 55
Blower and exhauster, Brakell's *53
Blower, Roots', as used for mine ventilation at the Chilton colliery, Eng *100
Blower, steam, for smithy forge, Korting *39
Blowers, force blast, Roots' *51
Blowing apparatus, steam, laboratory *233
Blowing engines for ventilation purposes. *142
Blowing engines, high-speed, Weimer Machine Works *51
Blowing engine, Morris *39
Blow-off cock, equilibrium, Booker's *91
Blow-pipe and spectroscope for mineralogists, Hall's *44
Blow-pipe and gas generator, Thomson's. *95
Blow-pipe bellows, new *131
Blow-pipe, gas, for tiring carwheels *337
Blow-pipe, gas, Wenham's *200
Blow-pipe, pocket, Casamajor's *13, *143
Blow-pipe reactions, by E. J. Chapman 99
Blows and pressure, relative value of, experiments on, by Prof. Kick 56
Blue prints, large, how to make 421
Boar, wild, and her young *345
Boat, Berthon's for pontoon bridge *199
Boat, coal, self-trimming *73
Boat, collapsible, Berthon *341
Boat, ferry, Loftus Perkins *217
Boat, how to tow with one man *358
Boat house, Oxford, Eng *243
Boat, life, with sea-dividing ends, Jackson's. *99
Boat, life and surf, Chapman's *6
Boat-lowering apparatus, improved *263
Boat-lowering apparatus, improved, Lawrence's *109
Boat-lowering apparatus, Pinker's *51
Boat, Nautilus, the small vessel that successfully crossed the Atlantic in 1878 ..... *145
Boat, racing, twenty-foot. Dimensions of a twenty-foot Australian boat for racing and cruising, with perspective view, diagrams, and details drawn to a scale *332
Boat, sail, small, for rough waters, directions for making *131
Boat, sail, sharpie model, details of construction and working plans drawn to a scale *177
Boat, sail, with roller center-board *134
Boat, torpedo, Garrett *218
Boat, torpedo, Herreshoff *169
Boat, torpedo (see torpedo boat).
Boat, tug, double-screw *23
Boat, tug, twin-screw, for the Rhine *396
Boats and rafts, portable, Stanley's *10
Boats and small yachts, rigs for various *131
Boats, apparatus for launching, Magnus' *160
Boats, canal, improvements in propelling, Bugbee's *6
Boats, cheap, how to build.—A series of plain, practical articles, showing how any intelligent person, by following the directions, may build a boat with economy. Each article is accompanied with drawings, diagrams, very full directions, dimensions, etc.
The three-dollar scow.—7 illustrations *25
The five-dollar rowing skiff.—13 illustrations. *26
The fourteen-dollar sailing skiff.—With 14 illustrations *29
The twelve-dollar row boat.—25 illustrations. Illustrates the construction of a graceful ribbed boat, light weight. *30, 32
The sixteen-dollar family boat.—With 7 illustrations. A handsome and commodious boat *36
The fifteen-dollar Whitehall row boat.—With 3 illustrations *37
The fifteen-dollar sailing and rowing canoe. With 8 illustrations, including perspective of double sail rig *39
A thirty-dollar yacht.—With 8 illustrations, including perspective of sail rig *42
A three-hundred-dollar center-board yacht.—With 10 illustrations. A fast and serviceable vessel *67
A five-hundred-dollar steam yacht.—4 illustrations *69
Boats, collapsible, by Rev. E. L. Berthon. Full description, and illustrations, by the inventor, of his system of folding boats *84
Boats, curious, at the Centennial *52
Boats, double, twenty illustrations of *232
Boats, ferry, of the port of Marseilles *299
Boats, fishing, at the Berlin Fisheries Exh. *241
Boats, high speed, hints on construction. *394
Boats, high speed, Raoul Pictet's *385
Boats, ice, velocity of *214
Boats, ice (see ice boats).
Boats, lines of, how to get, by R. Cooper. Practical directions both for designing and building small boats *140
Boats, novel rig for. A description, with complete working drawings, by H. R. Taylor, of a rig for small yachts, by means of which the sails may be lowered at critical moments *163
Boats, new cat-rig for, by Captain R. B. Forbes. A simple, handy sail that can be reefed from the standing-room in less than one minute. Adapted to cat, sloop, and schooner rigs. *133
Boats, small, steam for *158
Bobbins, throstle, drag for *170
Bobbins, warper, how made *109
Bobbins, warping, with iron heads *170
Bog land, reclamation of, by the German method of burying with gravel, by Prof. F. H. Storer. 221
Boiler calking, Connery's system of *41
Boiler casing and seating, Reilly's *43
Boiler drilling machine, Bowker's *258
Boiler experiment, Lawson's *341
Boiler experiments, Lawson's, at Pittsburg, Pa., by D. T. Lawson *313
Boiler economy, experiments and researches on, by the Societe Industrielle de Mulhouse *76
Boiler explosion at Dayton, Ohio *318
Boiler explosion, Jewell's Mills, Brooklyn. *333
Boiler explosion, experimental *313
Boiler explosion, Gaffney, W. B. le Vanon. 308
Boiler explosion, locomotive, remarkable. *266
Boiler explosion in Cincinnati, December 19, 1882, cause of, by Alfred R. Payne *376
Boiler explosion on the Thunderer *39, 40
Boiler explosions from Sept., 1876, to April, 1877. 72, 73
Boiler, gas heated, multitubular *263
Boiler house for Corliss engine at the Centen *14
Boiler incrustation, complete prevention of. 286
Boiler incrustations, tannates of soda for 137
Boiler, marine, new form of 89
Boiler inspection, new U. S. Government rules in respect to, and also to fire apparatus, boat lowering devices, and life preservers 113
Boiler inspection; rules of the English Board of Trade; instructions to surveyors 104
Boiler making, hydraulic flanging and straightening machine for *300
Boiler making, machine tools for *324
Boiler, marine, high pressure and light weight, Scott's *119
Boiler, paper pulp, Roeckner's *44
Boiler plate bending rolls, vertical *302

Boiler plates, exploded. Suggestions on the proper mode of investigating, by S. N. Hartwell, M.E. 289
Boiler plates, pitting of 73
Boiler plates, steel, of the Livadia, peculiarities of, by W. Parker 280
Boiler plugs, fusible *410
Boiler riveting; description of the various methods employed *296
Boiler shells, machine for drilling *66
Boiler, steam, Cooper's *66
Boiler, scale in, how to prevent 375
Boiler, steam, central feed, Thwaites' *215
Boiler, steam, exhibits of, at Centen. *45, *47
Boiler, steam, Moy's *312
Boiler, steam, reversible, Vail's *4
Boiler, steam, solar, Mouchot's *7
Boiler, steam, Shapley's *31
Boiler, steam, sectional, Babcock & Wilcox *72
Boiler, steam, vertical, Blake's *11
Boiler, tests, Manchester Steam Users' Asso. *74
Boiler tube cleaner, Meyer's *272
Boiler tubes, manufacture of *136
Boiler feed, automatic, Cohnfeld's *192
Boiler feed, automatic, Fromentin's *244
Boiler feed water heater, Strong's *363
Boiler feed water, Martin's *158
Boiler feed water, new magnesia process 154
Boiler feed regulator, Pope's *129
Boiler feeder and condenso-feed water heater, Fromentin's *346
Boiler feeders, self-acting, Cohnfeld's *139
Boiler for sharpie steam yacht *182
Boiler, varnish, with self-regulator, Werner *171
Boiler furnaces for smoke prevention, by Jno. W. Hill, C.E. 213
Boilers and engines for high pressures, Loftus Perkins' *81
Boilers, cast iron, fitting-blocks for, strength *51
Boil rs, elephant, Hall's *145
Boilers, exploded, of steamer Riverdale *407
Boilers, feed water pump for, Gauchot's *407
Boilers fitted with Fox's corrugated flues *293
Boilers, locomotive, fire-brick fire-boxes *172
Boilers of the Havemeyer Sugar Works *77
Boilers of the Hartford Steam Boiler and Insurance Co. *35
Boilers, safety disk for, Rowan's *93
Boilers, safety-plug for, Adams' *335
Boilers, safety and feed apparatus for, Lethuillier's *375
Boilers set in masonry, views of Engineer Isherwood on 240
Boilers, steam, at the Centennial Exhibition.—Notes on and descriptions of the various kinds shown 37
Boilers, steam, Babcock & Wilcox's *31
Boilers, steam, clothing for 17
Boilers, steam, corrosion in 194
Boilers, steam, electric chronograph for *173
Boilers, steam, Exeter *47
Boilers, steam, for very high pressures 132
Boilers, steam, Galloway at the Centennial *29
Boilers, steam, gas-fired. Account of recent efforts to construct furnaces for heating boilers with as little fuel as possible. Description of Muller & Fichter's producer, Heartmann's furnace, and Heaupt's new arrangement of fire-brick arches *219
Boilers, low-water alarm for, Kenyon's *20
Boilers, steam, mechanical firing of, by W. J. Pearse *77
Boilers, steam, priming of, by Wm. Major *82
Boilers, steam, riveted joints, by G. Cawley *96
Boilers, steam, safety apparatus for, Schwartzkopff's *357
Boilers, steam, safety plates for, Rowan's *96
Boilers, smoke from, device for preventing *33
Boilers, steam, tubular, vertical, improved *416
Boilers, steam, water gauge for *272
Boiling keir for yarn and cloth *341
Boiling points, a new and accurate method for determining with small quantities of liquid, by P. T. Main 64
Boils and carbuncles, how to treat, by Dr. P. Earl 58
Boils and carbuncles, remedy for 95
Bolivia, explorations in, Heath's, by Rev. J. D. Parker 410
Bolting mill, direct, portable, Aubin's syst. *236
Bones and superphosphates, relative values of as fertilizers 149
Boneblack, automatic appar. for washing *254
Boneblack revivifying appar., Schreiber's. *360
Boneblack, revivifying and washing, apparatus for, Daix's *349
Bone crushing mill, new *154
Bones, how to bleach 314
Book binding machines, Brehmer's *362
Book rack, simple, how to make *318
Book stitching machine for binders *110
Books, the insect enemies of, their natural history and ravages, and the methods of destroying them *138, *143
Book-cover, corner mount of 160
Book-cover, design for.—Balconies in wrought iron from Venice and Milan, by Myskovszky *91
Book-cover designed by Fischbach *128
Book-cover in leather mosaic, design for *239
Boomerang, African *9
Boot cleaning machines 42
Borax, action of on fermentation and putrefaction 2
Borax lake and sulphur and quicksilver deposits of California 38
Borax lakes of California 79
Border ornaments of marble for mosaic pavement, Siena cathedral *294
Borders, plain and ornamental *272
Boring rods, method of drawing, by R. Allison. *73
Boring, turning, and grooving machine, combined. Atock's *23
Borings, how to tell the inclination of *215
Bot-fly, horse, history of the, by Dr. N. Joly. A valuable paper *212
Botanical garden, Berlin, new building for the Victoria Regia *386
Botany and geology of the country bordering the Rio Grande in Texas and Chihuahua, by Dr. J. S. Newberry 411
Botany of Southern California 240
Botany of the Rocky Mountains, notes on, by Sir J. D. Hooker 105
Bottles, how to clean 318
Bouquetin at the Jardin des Plantes, Paris *209
Bourne, John, the mechanical engineer. Biographical sketch, with portrait *115
Boxwood, substitutes for, American 113
Brace problem, by A. F. Alexander *115
Bracket piano candlestick *143
Brain health, a lecture by Dr. J. Batty Tuke. 367
Brain, motor functions of; relations that exist between certain regions of the brain and the exercise of voluntary motions *210
Brain, remarkable injury to without serious results, by J. S. Beck, M.D. 378
Brain weights of historical characters 372
Brain work and hand work 386
Brake, Westinghouse's, for railway cars *122
Brake, car, automatic, Wilde's. *408
Brake, electric, Achard's. *312
Brake, compressed air, Colladon's *177
Brake, fan, hydraulic, improved *396
Brake for street cars, Phillips' *96
Brake, friction, automatic, Becker's. *251
Brake, high speed, electric, Spottiswoode's *51
Brake, hydraulic, Barker's. *78
Brake, Prony, electric compensator for *359
Brake, railway, electric, Achard's *111
Brake, railway, electric, Boothby's *221
Brake, railway, electro-magnetic, Wilke's. *411
Brake, steam, for locomotives, Hickey's. *101
Brake trials, recent 246
Brake, vac., Martin and Du Tremblay's. *359
Brake, Westinghouse *55, *392
Brakes, dynamometric, Deprez's and Carpentier's. *264
Brakes, railway. Abstract of a paper by Sir F. J. Bramwell 35
Brakes, railway. Abstract of a paper by E. Woods, C.E. 93
Brakes, railway, continuous, by G. Marie. *143
Brass and bronze metal to withstand the action of sea water, recipes for 318
Brass, green or golden colors for, how to produce, by E. Pulcher 392
Brass, how to clean and lacquer 108
Brass lamps, how to clean and brighten up 114
Brass, malleable, formula for 167
Brasses and bearings, heating and cutting in, some of the causes of, by Joshua Rose *3
Bread ovens, Lamoureux's *371
Bread making, the chemistry of, by Prof. Graham, D.Sc. A valuable paper 222
Bread making, theory of, by Mrs. G. M. Whitaker 170
Bread, mesquite 258
Bread mould, the growth of, as seen with the microscope *263
Bread, wheat meal, as a means of diminishing tubercular disease, by M. Yates 363
Breakwater, floating, Greenway's *405
Breakwater, the Tees *218
Breakwaters, improvement in, by John G. Bruggeman *25
Breathing, effective, influence of in delaying the physical changes incident to the decline of life, and in the prevention of pneumonia, consumption, and the diseases of women, by D. Wave, M.D. 387, *388
Breeding, scientific. A paper by J. D. Caton, on the scientific breeding of domesticated animals, especially of the horse, pointing out the improvements which, in recent years, have been successively wrought by intelligent and judicious selection 273
Brewers' building at the Centennial *16
Brewery, steam, Phœnix, New York 60
Brewing appliances, Cave's. *366
Brewing, Austrian. Description of an Austrian brewery plant, with illustrations. *256, *267
Brewing, Austrian, machinery for *265
Brewing, chemistry in its application to 287
Brewing, germinating grain for, Gruber's new method of *169
Brewing in Russia 148
Brewing, salicylic acid in, results 332
Brewing, dextrine maltose in. 19, 22, 25, 28
Brick kiln, Foster's *160
Brick kiln, railway, Foster's *186
Bricklaying, as practiced, in France *208
Bricklaying machine, Franke's *10
Brick machine, Allemand's *243
Brick machine, Brownhill's *78
Brick machine, Durand & Marais' *11
Brick machines, Greggs' and Craven's *40
Brick making machinery, Pinfold's *67
Brick manufacture, hints on *396
Brick walls, appar. for cleaning, Waterman's *21
Brick wall incrustations, by W. Trautwine 123
Brickwork. A valuable paper, by J. Woodley, containing many important hints on the proper mode of laying brick 397
Brickwork and masonry, by J. C. Jefferson. 148
Brickwork under water pressure, by D. McN. Stauffer, C.E. *350
Bricks, black, how prepared 58
Bricks, strength, experiments on 76
Bridge at Bismark, over Missouri River, N. Pacific R. R. with particulars and three pages of engravings *418
Bridge, Ashtabula, by E. S. Philbrick 61
Bridge and train, wreck of, by wind, on the Indianapolis and St. Louis R.R. *413
Bridge, Blair, Nebraska 416
Bridge, Calvert St., Baltimore *272, *273
Bridge, canal, at Blackburn *109
Bridge, cantilever and mid-girder, over the Thames, proposed *183
Bridge, Carlisle, Dublin *80
Bridge, carriage, over Penn. R.R., in Phila. *67
Bridge, Chaudiere, Ottawa. Description, with perspective view of bridge, map of locality, and vertical section of river bed and shores *283
Bridge, Clifton, suspension, Bristol, Eng. *159
Bridge, continuous steel-girder over the Frith of Forth, design for *317
Bridge, Conway, New Haven and N. R.R. *334
Bridge, Derwent River *178
Bridge, design for a steel-arched, 1,600 foot span, over the Frith of Forth, by M. Am Ende. *229
Bridge, Erie Canal. Brief description of a 234 ft. span, double track, truss bridge, constructed over the Erie Canal for the N. Y. Central R.R., with figures of elevation and details *329
Bridge, farm, cheap, how to construct. Full directions with complete working drawings of a model of an excellent and easily constructed spar bridge for crossing small rivers, streams, gullies and roads, where it would not prove economical to erect a costly structure *71
Bridge, floating, over the River Hooghly 118
Bridge, foot, at La Villette, France *381
Bridge, foot, over River Ness, Inverness. *80
Bridge, foot, Welland River, Eng.; with longitudinal sections, plans, and details. *321, *322
Bridge, foot, Woden St., Manchester *86
Bridge, Forth, proposed. General description, with figures showing elevation and plan *354
Bridge, Garabit, over the Truenyre, France. *391
Bridge, Girard Avenue, Philadelphia. A structure remarkable as the first attempt to combine the American system of pin-jointed, open-work girders with a solid roadway of stone. Perspective view, figures of details, and full particulars. *1, *2, *3, *4
Bridge, Harlem River. General description, with perspective view of the structure *350
Bridge, Illinois and St. Louis 61
Bridge, railway, iron, over Saint Leger Valley, France. Details, and plans and elevations of abutments, piers, girders, caissons, etc *377
Bridge, Irwell River, Manchester, England. Description, with two full-page illustrations. *76
Bridge, Kentucky River, on the line of the Cincinnati Southern R.R. *66, *95
Bridge, Kirchenfeld, at Berne, Switzer. *414
Bridge, Lansdowne, at the Centennial *43
Bridge, Llandaas *207
Bridge, Manawatu Gorge, New Zealand. *97
Bridge, New York and Brooklyn, over the East River at Blackwell's Island *118
Bridge, N. Y. and B'klyn, making cable for. *48
Bridge, N. Y. and Brooklyn, paint for. *379
Bridge, New York and Brooklyn. Brief summary of the dominant features of the structure; history, mode of constructing, cost, etc. *393
Bridge, 512 ft. span, Douro River, Portugal. *90
Bridge, New York and Brooklyn, pay of officers, engineers, and workmen 192
Bridge, Poughkeepsie, N. Y., progress of. 113
Bridge, new, proposed, the Thames, Lond. *86
Bridge, new, over the Medway, at Maidstone. Description, elevations, sections, etc *97
Bridge, Northeastern Railway, over the River Wear. Details of construction, with full-page illustration *261
Bridge, Ohio River, at Louisville, Ky. Description, with two full-page illustrations *55
Bridge over the Arroyo de Linares *409
Bridge over the Douro, proposed. Ten engravings showing general outlines of the respective designs presented to the bridge commission, with general particulars of each *267
Bridge over the Orange River *183
Bridge over the River Sli *409
Bridge piers, construction of without cofferdams or caissons, by W. Sooy Smith, C.E. 20
Bridge, Plattsmouth, over the Missouri. General description of the structure 239
Bridge, Plattsmouth, over the Missouri. Description, with figures *271
Bridge, Plattsmouth, over the Missouri River at Plattsmouth, Neb., from plans by George S. Morison. Eight figures showing perspective, vertical sections, caissons, piers, and map. *285
Bridge, Point, Pittsburg, Pa. Description of, with elevation, plan, cross-section, and details of the towers *34
Bridge, pontoon, Berthon's collaps. boat for *199
Bridge, Portage, on N. Y. and Erie R.R. *4
Bridge, proposed, between New York and Brooklyn, at Blackwell's Island *74
Bridge, proposed, over the Hudson River, at Poughkeepsie, N. Y. *66
Bridge, proposed, Royal Albert, at Montreal. General description, with lateral and end elevations, and perspective view *13
Bridge, railway and road, over Sarpsfos. *122
Bridge, railway, Indus *381
Bridge, railway, over the Atchafalaya, Louisiana, founding of the piers *387
Bridge, railway, Tay 133
Bridge, revolving, and traveling crane, at the Thavmont Quarries, Belgium *47
Bridge, rolling, proposed, over the Thames *20
Bridge, Rouchat, on Paris and Orleans R.R. *91
Bridge, Severn 202
Bridge, Severn. General description of 224
Bridge, suspension, between New York and Brooklyn, progress of *57
Bridge, suspension, Niagara 68
Bridge, suspension, Monongahela, at Pittsburg, Pa., detailed description of, by Col. S. M. Wickersham *389
Bridge, suspension, rigid, of three spans, design for, by T. Claxton Fiddler *24
Bridge, swing, at Hamburg *375
Bridge, Tay, fall of *214
Bridge, Tay, details of construction *216
Bridge, Tay, novel appliances and expedients used in the construction of *66
Bridge, Tay, official inspection and test of. 118
Bridge, the Albula, Solis, Switzerland *389
Bridge, the Kinzua Viaduct, Erie R.R., the highest bridge in the world *369
Bridge, Throstle Nest, Manchester, Eng *69
Bridge, timber, fifty years old, over the Kennebec River *138
Bridge, Brent, Hounslow and Metropolitan Railway, London *409
Bridge, truss, design for, by J. H. Snyder *87
Bridge vibrations, by Charles Seymour *389
Bridge vibrations, by Prof. S. W. Robinson. 381
Bridge, Victoria, Brisbane, Queensland. General description, with elevation, plan, and details of construction *10
Bridge, Yardleyville, Bound Brook R.R. *39
Bridge, Yazoo River, for the Louisville, New Orleans & Texas R.R. *410
Bridge, Weymouth Harbor. General description, with perspective view, elevation, plans, and sections *331
Bridges, American, and English engineers. 153
Bridges, causes of accidents to, method of detecting, by R. H. Thurston, C.E. *138
Bridges, double row girder, on the Hamburg and Harburg R.R. *222
Bridges, elliptical truss and compound truss, in wrought iron, by W. O. Douglas *80
Bridges, iron, American, peculiarities in designs of, and in methods of construction, as compared with European practice, by T. C. Clarke 32
Bridges in India, the Rari, Alexandra, and Jhelum 128
Bridges, iron, new systems of *233
Bridges, longest of the world 256
Bridges, masonry, observations on *350
Bridges on the Napier & Manawatu R.R., New Zealand. General description, with plan and elevation, and details of construction *296
Bridges, railway. Altier & Clse *321
Bridges, railway, Japanese *44
Bridges, railway, large span, comparative diagrams of *317
Bridges, railway, long span 132
Bridges, temporary, for use on farms, in gardens and parks, and in military operations, how made *239
Bridges, their care and maintenance, by Theodore Cooper, Am. Soc. C. E. 387
Bridges, truss, metallic arched, improvement in, by James B. Eads *8
Bright's disease, by B. A. Segur, M.D 228
Bright's disease, chronic, plan of treatment recommended at Bellevue Hospital 5
Bright's disease, cure of, by jaborandi. A clinical lecture by J. M. Da Costa, M.D. 150
Bright's disease, fuchsin in 259
Broca, Paul. Biog. sketch, portrait *253
Brood mares and foals, how to manage 127
Bromide of copper, uses, preparation 162
Bromine and iodine, manufacture of, from kelp, by R. Galloway, F.C.S. 149
Bromine, iodine, and nitrate of potash and soda, from sea weed, by T. Schmidt 116
Bromine still, new, Arvine's *60
Brontosaurus, restoration of, by Prof. O. C. Marsh *400
Bronze and brass articles, finishing, Dietlen's process for 39
Bronze and brass, to withstand the action of sea water, recipes for 318
Bronze, art works in, by B. F. Vors 5
Bronze, bismuth, how made 398
Bronze for feathers 163
Bronze for plaster casts 169
Bronze implements, early 414
Bronze, malleable 337
Bronze, manganese, malleable, for guns 31
Bronze, manganese, new, Parsons' 49, 51
Bronze, method of casting in 101
Bronze, phosphor, and its applications, by Alexander Dick 79
Bronzes, Chinese and Japanese, imitation, 28
Bronzes, French, composition of 169
Bronzes, Japanese, analysis of, by J. T. Matsdaira 342
Bronzing and brassing, electro, process of. 164
Bronzing for iron 235
Bucentaur, Venetian galley *62
Buckland, Frank. Biog. sketch, portrait *268
Buckwheat as a profitable crop 397
Buffalo race, a, in the Philippine Islands *273
Buffet, carved, design for, by Ph. Heussler *67
Buffet in walnut, by Mazaroz *123
Bug, carpet, by Dr. J. A. Lintner 88
Building blocks, the Z system of *203
Building materials, improvements in processes of manufacture. By J. W. Mallet 277
Building materials, oxidation of 278
Building materials, the porosity of, and apparatus for testing *224
Building materials: useful notes on limestones, Portland cement, Caen stone, marbles, alabaster, and slates 127
Building materials, nomenclature of, by J. R. Croes 113
Building of the Young Men's Christian Association, Philadelphia *90
Building, new, at Syracuse, N. Y. *98
Building stones, strength and fire resisting qualities of 317
Building materials, chemistry of 279
Building material, iron as 71
Building materials, microscopic organisms as destroyers of 387
Building materials, nomenclature of *113
Building materials produced in Maine 81
Building stone, the supply of 360
Building stones, decay of 372
Building stones, decay of, by A. A. Julien. 404
Buildings, English law decision concerning their right to be supported by the adjacent soil of another property owner 296
Buildings, masonry, methods of raising and moving to another location *404
Buildings, movable, 9 figures *426
Buildings, new, of the Metropolitan Artisans' and Laborers' Association *34
Buildings in glass *136
Buildings of British Commissioner and Delegates at Centennial *1
Buildings, undue deterioration of 297
Buoy, life, Whitby's *294
Bunsen, Robert Wilhelm. Biographical sketch and portrait, with a review of his contributions to science, by H. E. Roscoe *288
Bureau, Internat., Weights and Measures. *407
Burette for furnace gas analysis, Bunte's. *360
Burette, Pellet's *292
Burner, gas (see Gas burner).
Burner, gas, the Siemens and the Phare *271
Burns, clinical lecture, by Dr. H. J. Lewis. 176
Burns and scalds, chloral hydrate in, by Dr. S. S. Riddell 60
Burns and scalds, how to treat 224
Burns and scalds, the alkaline treatment of, by Dr. Geo. F. Waters 138
Burns, treatment of, by W. R. E. Smart 50
Busi, isolated, how produced *390
Butter, adulteration of, with other fats, rapid mode of detecting, by J. W. Gatehouse 6
Butter and buttermaking, by Dr. E. L. Sturtevant 282
Butter, artificial, manufacture of, by Prof. Henry A. Mott, Jr. Descriptions of the principal processes in use, details of latest improvements, plan of an artificial butter factory, the machinery required, chemical analyses of butter and artificial butter, the cost of setting up an artificial butter factory, capital required, materials and quantities consumed, cost of manufacture per pound, daily profit, etc 48, *49
Butter coloring. Harmless methods of giving butter a "rich golden color" 316
Butter making, centrifugal 262
Butter making, by Dr. Voelcker 302
Butter, Shea 184
Buttercups, how to rid the farm of *5
Buttercups, double.—Ligustrum quihoui.—Raphiolepis japonica.—Rionia lævis *358
Butterflies, interesting facts about 291
Butterflies, life of, by W. H. Edwards 314
Butterflies, pupation of, by C. V. Riley *193
Butterine manufacture, use of butter, milk, and mammary tissue in, by C. M. Tidy. F.C.S. 397

C

Cabbage worms, remedy against 252
Cabbages, how to store 310
Cable roads, a new source of power 334
Cable Railways, of San Francisco, 13 illustrations, *298; of Chicago, 5 illustrations, *334, *367
Cable, wire rope, apparatus, Bullivant's *244
Cables, ocean, progress of, in 1880 268
Cabinets, magic, how made *290
Cacao nut, its botanical origin, composition, and food value, by Prof. Boussingault 414
Cachou de laval, or patent dye of Croissant & Bretonnière, its mode of preparation and how used 238
Cœnurus of the hare, a new source of tapeworms, by Dr. Mary K. Curran 325
Calcimeter, Scheibler's *251
Calcium compounds, some of the industrial uses of, by Thomas Bolas. Four lectures replete with valuable information 327, 328, 329, 330
Calcium sulphide in glandular swellings, by T. Curtis Smith, M.D. 38
Calendering machinery, Voith's *245
Calender rolls, how ground *174
Calendering rolls, Voith's *210
California, irrigation in, by J. L. Dow 418
California, Southern, botany of 240
Calla lily, culture of 173
Callanish, standing stones of *186
Caloric engine, Ericsson's *70
Caloric engine, Rider's *49
Caloric engine, solar, Ericsson's *218
Caloric engine, the Sachsensberg *162
Calorimeter, Ericsson's *70
Calorimeter, the *218
Calorimeter, Thompson's *288
Caltrops, the water *425
Camera, enlarging and copying, Edwards' 131
Camera for the microscope, cheap and simple, how to make *218
Camera obscuras, improved, Kellett's *14
Camera lucida, Abbe's *393
Camera lucida, Grunow's *380
Camera lucida, Hoffman's, improved, also description of a simple form of the camera that can be made in ten minutes *158
Camera lucida for drawing *420
Camera lucida, made in ten minutes *155
Camera, multiplying, new *29
Camphor, how manufactured in Japan 413
Camphor, motions of upon water and mercury, by Prof. N. Joly *391, *401
Camphor, movements of on water, by P. Cassamajor 103
Camphor, sources of, and recent improvements in its purification 332
Canal banks, improvement in, by W. Rodney. *41
Canal boats, improvement in propelling, Bugbee's *6
Canal, Des Moines Rapids, hydraulic machinery for operating the lock gates of, by R. H. Jones. *280
Canal dredger, Rennie's *283
Canal, dry, for ships *218
Canal, interoceanic, problem. A paper by Edw. P. Lull, U.S.N. 195
Canal, Morris, and its inclined planes *373
Canal, or railway, which? Remarks of Mr. Eads before the House Committee on Interoceanic Canal, in answer to M. De Lesseps 221
Canal, Panama, beginning work on, with portrait of De Lesseps, its projector *270
Canal, Panama, by Manuel Eissier, M.E. A valuable and comprehensive paper, treating of the history of this and previous Isthmus canal projects, of the Panama Railroad, of the topography, geography, geology, and petrography of the Isthmus, and full details of the work to be executed. Illustrated with large map showing locations of the principal canal projects. 347, 349, 350, 355, *356
Canal, Panama, progress of the survey for, with panoramic view of the canal as planned by M. De Lesseps *305
Canal, Panama, progress of the work on the Colon section, with full page map and many figures. *412
Canal, Panama, map of *367
Canal, Panama, views on *418
Canal projects, interoceanic, a valuable paper, by A. G. Menocal, C.E. 212
Canal, ship, across Cape Cod 251
Canal, ship, Manchester, with bird's eye view, and plans and elevations *383
Canal, ship, Panama *282
Canal, ship, Welland *300
Canal, Suez, detailed description of the methods employed in constructing, and of the apparatus used, by M. Helene *343, *347
Canal, Suez, a general description of the great work, with maps, plans of the entrances, plan of the canal and the projected alternative canal, and a portrait of De Lesseps *400
Canal system of New York. A concise study of the present state and the possible future of New York canals, with historical notices of the engineers of the past and their works, canal projectors, engineering, original engineer corps, construction and maintenance, water supply, efects and remedies, steam propulsion, business, transportation, cost, Buffalo charges, proposed improvements, by Samuel McElroy, C.E. 291, 292
Canal, the Atlantic and Pacific Interoceanic, by Frederick M. Kelley 173
Canal tug, steam, new, Byne's 173
Canal through the Isthmus of Corinth *425
Canals, hydraulic elevator for *334
Canals, roads, tunnels, and bridges, by John Fowler 353
Canary birds, how to care for 248
Cancer and alluvial soil 373
Cancer, treatment of by hemlock 350
Cancer, treatment of with caustics, by Dr. Edgar Eltinge 272
Candelabra in bronze at the new Opera House, Paris *108

Candelabrum designed by J. Lefevre *69
Candle moulding machines, Morane's *292
Canes, paper, how to make *353
Canker worm, remedies against 19
Cannon, effects of gun cotton upon *165
Cannon, revolver, Hotchkiss *47
Cannon, steam engine, man, and the insect considered as mechanical motors 414
Cannons (see Guns).
Cannon ball tree *353
Canoe, a light paddling, by Chas. E. Chase. Description, accompanied by a full set of working drawings to a scale, of an easily constructed and cheap craft for small streams and frequent portages, capable of running safely through rapids in which heavier canoes would upset. *219
Canoe, cruising, Jersey Blue. A detailed description, by Commodore W. P. Stephens, of a new cruising canoe, embodying several improvements upon the established model, with a complete set of working drawings to a scale ... *164
Canoe, folding, Berthon *181
Canoes, canvas, for sailing and paddling. Description, accompanied by working drawings to a scale, of two light canoes, which can be built by any careful amateur, and which, with reasonable care in construction and use, will make handsome and durable boats *216
Canon, Grand, of Colorado River, by Capt. Dutton, U.S.A 305
Cans, tin, machinery for making *398
Capillarity, an interesting paper, by Geo. G. H. Stone 238
Capitals of pilasters, Italian renaissance ... *249
Caps from Ste. Chapelle, Paris *230
Capstan and windlass, hydraulic *217
Capsules, wafer, the filling of 93
Car and tender axie, standard recommended by master car builders of United States *294
Car axle journal box, Tomlinson's *118
Car axle, Miltimore's *277
Car axles, tests of, by W. E. Chamberlain ... *113
Car building 185
Car coupler, Janney's *165
Car coupling, dangers of *92
Car couplings, Bailey's *44
Car couplings, English. Full particulars of all the leading types *21
Car, drawing-room, detailed cost of 276
Car, electric, Siemens-Halske *292
Car, electric, storage battery *383
Car, first-class passenger, details of cost of construction 263
Car foot-warmers, arrang'm't for heating .. *176
Car for single-rail railway, James' *44
Car for tramways, Muir's *38
Car heating, French system of *177
Car load, the ordinary 58
Car, novel, for common roads, Prosser's *238
Car, railway, refrigerating *89
Car, railway, refrigerating, Winant's *18
Car, spring-propelled, Leveaux's *47
Car, spring-propelled, Steel & Austin's *46
Car springs at the Centennial 30
Car, steam, for tramways, new *36
Car, street, brake for, Phillips' *96
Car, street railway, compres'd air, Mekarski's *18
Car, street, steam, Brunner's *22
Car truck shifter, Ramsey's *45
Car wheel, Atwood's 34
Car wheel boring machine, Bement & Son's .. *33
Car wheel, genesis of a 408
Car wheels and axles, boring and fitting *11
Car wheels, balancing, apparatus for *176
Car wheels, breakage of 290
Car wheels, chilled cast iron, mode of making 31
Car wheels, cast-iron, turned, experiments with 15
Car wheels, foreign, at the Centennial 29
Car wheels, how to balance *368
Car wheels, improved, Paige's *1
Car wheels, large versus small *67
Car wheels, tiring and untiring, apparatus *337
Carbolic acid for boils, ulcers, poisonous bites, hemorrhoids, carbuncles, and tumors, by Dr. N. B. Kennedy 336
Carbolic acid, how to test the commercial value of, by Dr. O. Bach 361
Carbolic acid, med. uses of, by P. Eade, M.D. 138
Carbon, action of watery vapor on at different temperatures, by C. G. Dahlerus 224
Carbon, distribution, characteristics and combinations of, by T. A. Pooley 288
Carbon, how to print in 66
Carbon minerals, origin and relation of. An interesting and valuable review of the genesis of carbon minerals, and the modes and conditions of their occurrence, by Dr. J. S. Newberry . 362
Carbon paper, apparatus for preparing ... *153
Carbon pictures, printing ornamental borders to, by E. W. Foxlee 1
Carbon, plastic, for batteries, how made 415
Carbon points for electric light, by F. Carre .. 98
Carbon prints, development of, by Mr. Lamy . 114
Carbon prints, fading of 152
Carbon process, improved 119
Carbon, proportion of wasted as soot 387
Carbon sulphide furnace, Labois' *299
Carbon surfaces, colored, absorption and repulsion of the chemical rays by, by E. Lacan ... 157
Carbon, the spectrum of, by G. D. Liveing and J. Dewen 343
Carbonic acid, antiseptic properties of 392
Carbonic acid in the atmosphere *259
Carbonic acid in the atmosphere, abstract of a paper by E. H. Cook 393
Carbonic acid in the air, by M. Dumas 358
Carbonic acid in occupied rooms, diffusion .. 170
Carbonic acid, liquid, in minerals, by Walter Noel Hartley, F.C.S *23
Carbonic oxide and oxygen, explosion of, influence of aqueous vapor on 358
Carbons, electric light, machine for making, Cunliffe's *417
Carbonizing apparatus for beet root molasses residua *376
Carbonizing apparatus for gas manufacture, Carpenter's *144
Carbuncle, carbolic acid in 138
Carbuncles and boils, how to treat, by Dr. P. Earl 58
Carbuncles and boils, remedy for 95
Carbuncular disease, etiology of, by L. Pasteur. An exhaustive contribution to the history of anthrax, one a disease which causes great destruction of cattle in all countries *259
Card player, automaton, new *106
Card table inlaid with ebony and yellow and green ivory, designed by Paul Faure *31
Carding engine for tow and jute *106
Carding engines, Klein's *78
Carding engines, improved, Bolette's *344
Carding machine, Pierrard-Parfait's *166
Carding machine, Truxler's *379
Cargo block, Laurence's *253
Cardol, irritating effects, by Mrs. Ida R. Brigham 336
Carp, German, how to cultivate 420
Carpenter, Dr. W. B. Biographical sketch, with portrait *325
Carpenter's square, how to use, a valuable paper by John O'Connell *88, *89
Carpentry, questions and replies in, 47, *55, *56, 60
Carpet beetle and other domestic pests, by Dr. H. A. Hagen, a useful paper 161
Carpet bug, by Dr. J. A. Lintner 88
Carpet designing for women 315
Carpet, German, old, design of *93
Carpet loom, power, Gates' *79
Carpet patterns, veteran *331
Carpeting, rag, artistic, how to make 322
Carpet sewing machine, Hesse's *239
Carpets, Brussels, how manufactured 39
Carriage and car seat, suspension, Delessert's system of *347
Carriage draughting, perspective, by A. Muller. *267
Carriage exhibit at the Centennial. 30, *33, *37
Carriage painting, by W. H. Stewart 100
Carriage painting, how can the present method be improved, by W. H. Stewart *98
Carriage, steam, high-speed, Bollee's *398
Carriage, steam, for roads, Bollee's *291
Carriage terms, dictionary of 396
Carrots, how to harvest *206
Carrying trade of the world 240
Cars, colliery, wheels for *95
Cars, electric light for, Klabath's *406
Cars, freight, standard of the New York Central and Hudson River Railway, with working drawings and full specifications, showing dimensions and all particulars *18
Cars, passenger, most economical length for. 26
Cars, painting, varnishing, and cleaning of; the subject as discussed by the Master Car Painters' Association 204
Cars, railway, construct'n, past and present .. 203
Cars, railway, costs of 204
Cars, railway, iron 57
Cars, running gear for, Raddin's *380
Cars, safety device for, Root's *9
Cars, steel, for railways *38
Cars, street, at Nantes *357
Cars, street, compressed air motors for, by Gen. H. Haupt, C.E 176, 177
Cars, street, improved 89
Cars, street, steam, horse power, etc., required for 28
Cars, street, spring-propelled, Jones & Terflott's. 48
Cars, street, steam, surface-condenser for, Rowan's *31
Cars, taking-up by a train in motion, Hanrez's system *256
Car-truck, 6 wheeled, freight *426
Cart horse show, London *277
Cartometer, the *212
Cartridge shells, appar. to utilize, Morris' *276
Cartridges, how manufactured *24, 168
Cartridges, lime, for blasting, how made and used 416
Cascara sagrado, articles on its use, by Drs. Gundrum, Bundy, Bean, Fowler, Buckland, and Galloway 164
Cashmeres and silks, how to clean and how to dye with resists 218
Casket in oak, carved *232
Casks, new, how to remove the unpleasant taste from 256
Casting metals, medallions, vases, and other articles in fusible alloys. Full directions for home and shop practice, with engravings showing how to make the moulds, how to make the air vents, how to prepare the alloys, and how to put the final finish on the castings, by George M. Hopkins *17
Castings, cooling, Robinson's process 72
Castings, heavy, burning or mending, by T. D. West *269
Castings of insects, etc., how to make 311
Castor bean, how cultivated and harvested, by Edw. Ballaine 186
Castor oil, a substitute for 226
Casts and models, a new material for 378
Cat and its relations, by F. A. Lucas. An interesting paper, showing by means of the cat as an example how animals are classified 293, 294
Catalepsy and hypnotism *295
Catalepsy and somnambulism, hysterical, induced, by Prof. Charcot 256
Catalpa tree, importance of for economic planting, by C. S. Sargent 132
Catamaran, American, in London *246
Catamaran, or double-hulled sailboats, how to build. Full directions for construction, dimensions, and illustrations of three sizes, costing from about $50 to $500. Also, interesting description of Mr. Herreshoff's patent catamarans, speed 20 miles per hour *105, *106
Catamaran, or double-hulled sailboat, with Malay rig, in use in San Francisco harbor. Directions for constructing a cheap, simple, and handy boat, with four figures *117
Catamaran, pleasure, proa Ladrona, with details of construction *225
Catamaran, small sized, successful 109
Catamaran steamer, new *225
Cataract of the eye, mode of operating for. *139
Cataract of the eye, treatment of, by B. W. Richardson, M.D 50
Catarrh, a cure for 216
Catarrh, by Dr. Dudley Reynolds. A valuable clinical lecture on the character and treatment of the disease 84
Catarrh, nasal, by Dr. F. H. Bosworth 262
Catastrophism and its connection with evolution. An interesting address before the Sheffield Scientific School, by Clarence King 80, 81
Cathedral, Carlisle *244
Cathedral, Chichester *290
Cathedral, Cologne *257
Cathedral, Cologne, placing the capstone of upon the finial of the south tower *265
Cathedral, Ely *145
Cathedral, Glasgow *300
Cathedral, Gloucester *341, *413
Cathedral, Lichfield, England *219
Cathedral, Lincoln *262
Cathedral of Burgos, interior view of ... *354
Cathedral of Burgos, Spain *344
Cathedral, Peterborough *285
Cathedral, Ripon *335
Cathedral, Rochester *321
Cathedral, St. Paul's, London *374
Cathedral, Wells, England *196
Cathedral, Winchester *319
Cathetometer, and its practical applications, by Prof. A. M. Mayer *77
Catsup under the microscope, by W. G. Smith. *310
Cattle, Aberdeen, prize at the Paris Exhib. *177
Cattle and live stock, diseases of, salicylic acid for the cure of 244
Cattle, Hereford *149
Cattle, how shipped to Europe 305
Cattle, Long-horn, history of, by J. N. Fitt .. *20
Cattle, musk, of America, by Dr. G. A. Stockwell 400
Cattle, Montbeliard breed of *152
Cattle, prize, at the Paris Exhibition *141
Cattle, short-horn, prize *27
Cattle, Stalled, how to keep clean *105
Cattle, Sussex *70
Cattle, white, early, of Great Britain *187
Caustics for the removal of malignant growths, by Dr. Francis H. Stuart 272
Caustic pencils, how to make 81
Cave, ice, of Dobschau *195
Cave, pictured, of Wisconsin, by Rev. Edwin Brown 190
Caves, exploration of, by aid of electricity. *416
Caves, Mexican, with human remains, by Edward Palmer 333
Caves, saltpeter, in Virginia, by H. Haupt, Jr. 184
Caves, wonderful, of Kentucky 88
Caves, Western, discoveries in, by H. C. Hovey. 162
Cayenne pepper, microscopic study of, by Thos. Greenish *258
Cayley, Prof., President of British Association. Brief sketch of, with portrait *409
Cedar of Lebanon 89
Cedar, white, characteristics and uses of 345
Cedars, California 365
Ceiling flowers in carton pierre *106
Ceiling of a villa boudoir in Wiesbaden ... *116
Ceiling ornament, designed by Pallenberg.—Marquetry designs, by Petronio *89
Celery, how to blanch *397
Celestial bodies, atmosphere of, by J. L. Landeur. 258
Celestial dynamics; do the planets move round the sun, by James W. Hanna *39
Celestial indicator, Mauperin's, for finding the constellations *39
Celestial objects of interest that are to be seen with the naked eye, by W. F. Denning 214
Cell doctrine, in the light of recent investigations, by Dr. C. Heitzmann. A valuable paper .. *87
Cellars and diphtheria, by Dr. A. G. Field 3
Celluloid, apparatus, French *265
Celluloid, parkesine, and xylonite 227
Celluloid, chemical formation of 237
Cellulose, chemical formation of 46
Cement and mortar, strength of 325
Cement, beton, and artificial stone 8
Cement for fastening rubber to metal 213
Cement for glass and earthenware 172
Cement for joining metal to glass, recipe for 163
Cement for metals, glycerine, recipe for 70
Cement for woolen baths, recipe for 369
Cement, Japanese, a natural *147
Cement, machine for testing, Michaelis' ... 350
Cement, manufacture of, at Folkestone ... 231
Cement, Portland, by Mr. Watson 386
Cement, Portland, its manufacture and uses, with analyses of materials, comparisons with other cements, etc., by Reginald E. Middleton. A valuable paper 84
Cement, Portland, manufacture of, improvments in 90
Cement, Portland, results of tests as to its resistance to crushing *405
Cement, process of manufacture in Ulster Co., N. Y *388
Cement reservoirs, how to construct *235
Cement testing apparatus, double lever, Fruhling & Michaelis' *424
Cement testing machine, Fairbanks' 216
Cement to resist acids, recipe for 48
Cements, a collection of valuable recipes for 158
Cements, American 245
Cements for the teeth, recipe for 200
Cements, hydraulic and others, at the Philadelphia Exhibition, notes on, by Q. A. Gillmore, U.S.A 64
Cements, tensile strength, appar. to test .. *282
Cements, various recipes for 133
Cemetery new, Madrid, design for *176
Centennial Exhibition building *3
Center of gravity, experiments on *237
Central Institution for Technical Education, London *318
Centrifugal cream separator, improved .. *263
Centrifugal force apparatus, novel *361
Centrifugal force, experiment on *321
Centrifugal machines for the separation of cream from milk, notes on the efficiency of, by A. Smetham, F.C.S 320
Century plant, Queen Victoria *401
Cephalopoda, ink-bag of 359
Cereal foods. A microscopic examination of some cereal foods which are extensively advertised, showing those that are genuine and those that are fraudulent and valueless *328
Cereal foods, by Dr. A. T. Cuzner. A paper treating of wheat and its approximate principles, and its manufacture into various kinds of bread *390, *391
Cereal foods in their relation to health and disease, by Dr. F. R. Campbell 392
Cerium aniline black, preparation of 182
Cerium oxide, preparing, by H. Debray 412
Cerro de Pasco, Peru 211
Ceylon and India, notes on, by Prof. Ernst Haeckel 348
Chain belts, improved, Bushnell's *6
Chair, hardwood, design for *192
Chair, ornamental, designed by Schuh *92
Chairs and writing table, by Schoenthaler. .*43
Chairs, designs for *255
Chairs, Flemish renaissance, from the collection in the Louvre *397
Chairs, ornamental, designed by Ludwig ... *83
Chambers, Dr. William, sketch of his life, with portrait *393
Chameleons, by Prof. J. Reay Greene. An interesting paper *233, 234
Chameleon, how it changes color *157
Champagne making in France 423
Chancre from a dentist's instruments 111
Chandelier, corona lucis *187
Charbon vaccination *337
Charcoal, animal, apparatus for revivifying, Schreiber's *360
Charcoal, animal, oxidizing action of, by W. Thomson 67
Charcoal, how made, and where the city supply comes from 285
Charcoal, manuf. in kilns *422
Charcoal, manufacture of in kilns, description and figures of the different kinds of kilns used in the industry, by Prof. T. Egleston *415
Charcoal, peat, manufacture of *137
Chasles, Michel, the mathematician. Biographical sketch of 280
Chateau, castellated, English *303
Cheese mould *271
Cheese presses, English *155
Cheeses, European *29
Chemical action in a magnetic field, by Ira Remsen 293
Chemical action, modern ideas of, by Prof. Dewar 145, 146
Chemical affinity, thoughts on, by C. Morris .. 347
Chemical analysis, method for the separation and subsequent treatment of precipitates in, by F. A. Gooch *216
Chemical apparatus, manipulation of, methods of grinding, boring, inserting, fastening, and removing glass stoppers, boring, pressing, cutting, and fastening cork stoppers, pouring from bottles, inserting tubes, preservation of corked vessels, etc *290
Chemical combination, suspension, and solution, by William Durham *116
Chemical compounds, dissociation of, by Dr. William Wallace 322
Chemical compounds made by compression, by W. Spring 404
Chemical compounds, unit weight and mode of constitution of, by Dr. Odling 324
Chemical decomposition incited by a cold fluid stratum floating on a warm liquid, by Henry A. Mott, Jr *272
Chemical decomposition, methods of, as illustrated by water, by Prof. J. E. Gladstone 38
Chemical energy and electromotive force of different gal. combinations, by J. Thomsen .. 279
Chemical experiments in the lantern 425
Chemical experiments in dyeing 257
Chemical generators of combustion 253
Chemical harmony of the universe, abstract of a paper by Dr. T. S. Hunt 65
Chemical industries of Italy, present state .. 348
Chemical industry, new, established by Camille Vincent, the production of methyl chloride from beet root vinasses, by Prof. Roscoe *172
Chemical industry of Germany at the Centennial 39
Chemical phenomena, influence of vibrations on, apparatus to study, Berthelot's *240
Chemical reactions, blowpipe, by E. J Chapman 99
Chemical reactions, simple methods of recognition for some of the chemicals of most frequent occurrence in photographic practice 348
Chemical reagents, an enumeration of 26 valuable reagents, with their mode of preparation, tests for their purity, and their uses 296
Chemical reagents, by M. W. Iles; impurities detected in reagents used in qualitative analysis, with nature of impurity, and name of manufacturer 98
Chemical recreations, a paper by A. R. Prescott, M.D., describing some instructive experiments that illustrate various forms of oxidation ... 183
Chemical science, an address before the British Association by Prof. J. H. Gladstone. A valuable and interesting paper 408
Chemicals, recent improvements in the manufacture of, by J. W. Mallet 221
Chemicals used in the various picture-making processes, their manufacture and their properties, by John L. Gihon 114
Chemigraphic engraving 370
Chemistry and biology, borderland of 289
Chemistry, analytical, recent improvements in, methods used in 289
Chemistry as an art and as a science, by Prof. J. M. Ordway 247
Chemistry, blowpipe, contributions to, by P. Casamajor *131, *143
Chemistry, educational, value of, by Prof. Maxwell Simpson 151
Chemistry for amateurs, a description of some interesting chemical experiments that require for their performance, simple and easily constructed apparatus only *259
Chemistry, industrial, applica. of cold in .. 254
Chemistry, industrial, methods of analyzing soap, by Dr. Albert R. Leeds 374
Chemistry, industrial, progress of, by J. W. Mallet. A brief review of the most important changes in the industrial applications of chemistry within the last few years. A valuable series of papers .. 186, 188, 204, 214, 221, 232, 237, 261, 277, 287
Chemistry, microscope in, by H. C. Sorby .. 124
Chemistry of plants, by R. Warington 175
Chemistry of the barks of the oak, willow, and elm, by E. Johansen 87
Chemistry, organic, teaching, by Prof. Edward J. Hallock 372
Chemistry, outlines of, by H. M. McIntire, M.E. A plain and concise account of the various chemical elements, with their atomic weights, tests, compounds, practical uses, etc. 136, 144, 145, 153, 158
Chemistry, pure, review of the progress of during the first three months of 1882 342
Chemistry vegetable, abstract of a paper by S. H. Vines 129
Chess record, Scientific American. A series of papers of the greatest interest to all lovers of chess, giving selections from all the famous problem tournaments, and full information in regard to them; annotations of decisive games from celebrated matches, with complete scores, etc.; and sketches and portraits of leading problemists and players, and the finest examples of their skill. The series is illustrated with the following portraits:
Dr. C. C. Moore *84
Samuel Lloyd *85
Harry Boardman *86
Mrs. J. W. Gilbert *87
W. A. Ballantine *88
Adolph Anderson *89
Jacob Edson *90
W. Steinitz *91
Howard Staunton *92
R. H. Seymour *93
H. S. Bird *94
N. Marache *95
J. G. Belden *96
J. H. Finlinson *97
Herr Harrwitz *98
T. M. Brown *99
Dr. R. L. C. White *100
R. B. Wormald *101
M. J. Hazeltine *102
I. Kolisch *103
C. A. Gilberg *104
L. W. Mudge *105
B. S. Walsh *106
Frank Norton *107
James Mason *108
Max Peiler *109
W. S. Hallock *110
H. F. L. Meyer *111
F. M. Teed *112
E. Delmar *113
B. R. Foster *114
P. T. Duffy *115
C. H. Wheeler *116
Francois A. D. Philidor *117
Louis C. De la Bourdonnais *118
C. H. Waterbury *119
J. Lowenthal *120
F. Healy *121
G. H. Mackenzie *122
John Cochrane *123
J. A. Graves *124
S. Rosenthal *125
Herr Horwitz *126
Miss M. Rudge *127
F. E. Brenzinger *128
J. A. De Riviere *129
W. Grimshaw *130
G. N. Cheney *131
Geo. Walker *132
Pierre C. F. De St. Amant *133
Joseph A. Potter *134
E. S. Brewster *135
Chestnuts, how to grow from seed 91
Chicory, large-rooted, how to cultivate .. *372
Chicken cholera. An important paper by L. Pasteur, showing how chickens may be preserved from death by inoculation with the virus of the disease 271
Chicken cholera and other virulent diseases, by L. Pasteur 242
Chicken cholera, attenuation of the virus of, by L. Pasteur 283
Chicken cholera. Study of the conditions of non-recidivation and of some other characteristics of the disease, by L. Pasteur 274
Chicken lice, how to destroy 105
Chicken raising, artificial, hints on 414
Chickens, hatching of, artificial *54
Children, psychological development in, by G. J. Romanes 358
Children, young, care of. Valuable paper .. 192
Chimborazo and Cotopaxi, ascent of. An interesting paper by Edward Whymper, giving an account of his ascent of these two lofty volcanoes, and containing much geographical and ethnological information that is not generally known. 277, 278
Chimes, new mechanical system of ringing *282
Chimney construction, by J. M. Bancroft. A valuable paper 116
Chimney straightening by a process requiring no scaffolding 3
Chimney sweeping, air-blast, Sylwaschy's *351
Chimneys, tall, apparatus for climbing *10
Chimneys, hints on building, by D. Morse ... 163
Chimneys, hot water, and hot air stoves. *213
Chimneys, the draught of, mode of calculating, valuable particulars 369
Chimney-piece and ornaments, Flemish renaissance style *145
Chimney-piece, designed by M. Seguin, Paris. *51
Chimney-piece, Italian, in marble *121
China and Japan, scientific progress in 392
China clays, method of bleaching 91
China, great wall of *319
China grass, cultivation and utilization of .. 417
China painting, directions for practicing the art of 199
Chinch-bug, devastations of 420
Chinch-bug, its injury to agriculture 218
Chinese finger-nails *19
Chinese in California 241
Chloral hydrate in scalds and burns, by Dr. S. S. Riddell 60
Chloral inebriety, by Dr. J. B. Mattison 212
Chloride of lime manufacture, Weldon process. 206
Chlorine, contribution to the knowledge of 229
Chlorine, action of, by Edmund W. Davy .. 147
Chlorine, decomposition of 197
Chloroform, pure, tests for 323
Chlorophyl, animals containing, researches on, abstract of a paper by P. Geddes 324
Chlorophyl, by E. Fremy 192
Chlorophyl, by R. Sachsse 325
Chlorophyl, function of 211
Chlorophyl, functions of, Pringsheim on .. 225
Chlorophyl, Pringsheim's researches on, by Sydney H. Vines 293
Cholera germs, Dr. Koch on 414
Cholera infantum, treatment of, by Dr. W. F. Hines 190
Cholera, poultry, how to prevent and cure .. 298
Chrome, application of in printing tissues 91
Chromium in photography 11

Chromo photo., new Albert-type....131
Chronograph, Dent's....*280
Chronograph, electric, for steam boilers.*173
Chronograph, falling, electric, Bianchi's*318
Chronograph, Schultz, Deprez's modifica.*318
Chrysalis, experiments on the temperature of, and its defenses against cold....*228
Chrysanthemum, culture of....381
Chuck, Sweetland....*409
Chucks and methods of chucking....*311
Church, Bath Abbey, England....*169
Church, memorial, St. Petersburg....*345
Church of the Oratory....*181
Church, St. Mary's, Brighton, Eng....*218
Churches, country, classic design for....*320
Cider and apples, how to keep fresh....59
Cider, how to make and how to keep....*313
Cigar lighter, electric, Edison's....*411
Cinchona plants, hints for raising....342
Cinnabar, preparation of in the wet way... 58
Cinnamon, how cultivated in Ceylon....*403
Circle, quadrature of....*282
Circle, quadrature of the....287
Circulator, continuous, Bourdon's....*389
Cistern, filter, self-cleaning....*110
Cistern, filtering, Moscucci's....*145
Cistern, water, position of, valuable suggestions in regard to....219
Cistern water, analyses of Dr. Stuntz to determine sewage and other impurities in....277
Cisterns, rain water, how to construct....150
Cities of Europe, great, populations of....395
Citric acid, artificial....264
Citric acid, manufacture of, by J. Carter Bell, F.C.S. An important practical paper....244
Citric acid, recent improvements in the manufacture of, by Robert Warrington....18
Citrine ointment, by J. U. Lloyd....190
City and Guilds Institute of Technical Education, London....*297
City of London School....*423
City, manufacturing, co-operative....165
City Hall, new, Vienna, page eng....*418
Clamps, long, how to make from broken hand screws....*257
Clay, lump of, chemistry of....281
Clay, modeling in, by Edw. A. Spring....181
Clay mill and engine combined, Jackson's...*70
Clay pipes, how made....361
Clays, general characteristics of....383
Clays, pottery, method of washing....340
Cleopatra's needle, removal of, to England.*69
Cleopatra's needle, removal of, from Egypt and erection on the Thames embankment....*150
Cleopatra's needle, removal of, from Egypt to New York. Full details, accompanied with a history of this and other similar Egyptian monoliths....*223, *267
Cliches, pellicle, how to produce and how to obtain portrait and framework at one printing. 17
Climate, arid, of the western portion of the U.S., cause of, by Capt. C. E. Dutton....319
Climate cure in nervous diseases, a lecture by William F. Hutchinson, M.D....213
Clip for tentering machines....*329
Clock, a historical....*376
Clock and candelabrum, style of Louis XIV.*64
Clock, century, Hile's, for telling the year, month, day, hour, and minute for a hundred years....*44
Clock chimes, electric, for ordinary clocks..*44
Clock, hydropneumatic motor, Bourdon's.*355
Clock in carton pierre, design for....*99
Clock, lapis lazuli....*222
Clock, marble, ornamental, designed by O. Gradler, Berlin....*36
Clock makers, hand turning tool for....*87
Clock, spherical, of the 17th century....*394
Clock, three wheeled, seven-day, novel....*14
Clock tower, Scandinavian....*153
Clock, turret, musical and chiming, for Bombay University....*60
Clock without hands, Gillett & Bland's....*28
Clocks and clock work, electrical....*198
Clocks, compressed air, description of the pneumatic clocks inaugurated in Paris....*293
Clocks, pneumatic, Mayrhofer's....*84
Cloisonne, manufacture of at Peking....333
Cloth, center selvage in, how formed....*60
Cloth cutter, Sanson's....*28
Cloth, fabrication of, by the Ainos....*244
Cloth, how to make waterproof....317
Cloth pressing machine, Gessner's....*344
Cloth stretching machine, improved....*401
Cloth tracings, how to make....356
Clothing, improvements in the materials and processes connected with, by J. W. Mallet..261
Clothing in relat'n to health, by Prof. Jaeger 253
Clothing in its relation to health, Prof. Jaeger's expedient for preventing the accumulation of fat and water in the system by the adoption of a new sort of woolen clothing....256
Cloth-press, improved hydraulic....*426
Clouds, by Prof. S. A. Maxwell. An interesting exposition of the nature and causes of clouds, and laws which govern their formation....260
Clouds, distance of, method of determining the heights and distances of clouds by their reflection in a low pool of water, and in a mercurial horizon, by Francis Galton, M.A....253
Clouds, height of, new mode of measuring, by A. Mallock....*93
Clouds, how to measure the height of, by Alex. Ringwood....*99
Clover, value of to farmers....85
Club foot, spine curvature, and hip joint disease. A clinical lecture, by Prof. Lewis A. Sayre....122
Coach building, art, history of, by G. A. Thrupp. An interesting paper....57, 58
Coach, Herdic....245
Coach painting, a practical paper, full of valuable hints on the subject of painting and decorating coaches....262
Coal ashes as a fertilizer....136
Coal and gas, comparative values of, as fuel.216
Coal and gas fuel grate, Siemens'....*266
Coal and iron in Alabama....285
Coal blast and petroleum furnace....*8
Coal, bitum., how it poisons the atmosphere.325
Coal, bituminous, production of, in the United States, interesting data regarding....323
Coal, chemistry of, abstract of a lecture by Dr. Frankland....58, 59
Coal, combustion of, in boiler furnaces....191
Coal consumed per horse-power per hour...284
Coal cutting mach., hand power, Lilienthal's*163
Coal cutting machine, improved, Brown's.*107
Coal dust fuel, appar. to burn, Stevenson's..*82
Coal fields, anthracite, of Pennsylvania and their exhaustion. An interesting statistical and critical review of the geology and industrial development and future prospects of our anthracite coal deposits, by P. W. Sheafer, M.E....241
Coal fields, vast, of New Mexico....67
Coal, fine or pulverized, apparatus to wash*273
Coal, fossil, coloring matters obtained from.. 95
Coal gas and air, explosive mixture of..243, 245
Coal gas as a fuel for boilers, advantages of, by L. Paulin....153
Coal gas as a means of ventilation....391
Coal gas, heating power of....216
Coal gas, hydrocarbon vapors and gaseous hydrocarbons in, their relative illuminating value and their quantitative determination, by G. E. Stevenson....*251
Coal gas, new products obtained from, by Lewis Thompson....120
Coal gas, sulphureted hydrogen and carbonic acid in, estimation of, by L. T. Wright....*330
Coal gas, the heating power of....216
Coal gas, use of for lighting and heating, by Prof. Armstrong....335
Coal, geology of, by Prof. Green....173
Coal getting machine, Riggs-Meiklejon....*236
Coal, mineral, chemical composition of....192
Coal mines, automatically closing ventilating chambers for....*361
Coal mines of Trinidad, by I. T. Goodnow....412
Coal mines, remarkable, of Peru....86
Coal mines, working of, by electricity....402
Coal mining at Mt. Diablo, Cal....191
Coal mining at Steubenville, O....72
Coal, new residual product from....418
Coal, parallel wedge expander for mining.*120
Coal, red ash, superior calorific qualities of.. 65
Coal refuse, machine for compressing into fuel, Bilan's....*360
Coal required to puddle a ton of iron....*76
Coal seams, inclined, of Dombrowa, Poland.. 68
Coal, solid, gas pressure in....310
Coal tar, artificial coloring matters derived from, by Prof. Adolph Wurtz. An elucidation of the chemical processes for obtaining nitro-toluene, toluidine, aniline, rosaniline, phenylamine, artificial madder, and other dyes, and the industrial processes employed for their production....*57
Coal tar, coloring matters from, history of the industry, by W. H. Perkins, F.R.S. A comprehensive and valuable paper....186, *187
Coal tar colors, by Geo. Jarmain. A valuable paper....68
Coal tar colors, how to detect, by J. Spiller..260
Coal tar, distillation of, Scotch system....*172
Coal tar dyes, manufacture of....*343
Coal tar, its components, and the development of coal tar dyes, by S. A. Sadler....361
Coal, the iron trade as a consumer of....323
Coal, the physical conditions under which it was formed, by Prof. J. S. Newberry....383
Coal, tipping and screening app., Riggs'...*332
Coal, volatile constituents of, new process for separating and recovering, by T. B. Lightfoot. A valuable and important paper....399
Coast warning, submarine, Perry's....*283
Cobalt and nickel, how to distinguish in a mixed solution, by Dr. G. Papasogli....222
Cobalt and nickel, new method of separating. 58
Cobalt and nickel, how to render malleable..224
Cobalt, electroplating with, process of, by I. Adams....13
Cobra and mongoose, by G. A. Stockwell....424
Cobric acid crystals, the microscopical active principle of the cobra poison....*89
Coccidæ, by Dr. H. Behr. A paper treating of the natural history of "scalebugs," and showing how these insect pests should be combated..286
Cochin China, particulars about....423
Cocoa, how manufactured....64
Cocoanut fiber, characteristics and uses of..394
Cod, boneless, how cured and prepared for the market....250
Cod fishing in Norway....72
Cod liver oil, a homely substitute for....226
Codlin moth, how to destroy....254
Coffee and sugar, physiological action of....322
Coffee, an interesting account of the plant and its fruit....308
Coffee pot, design for, by Villain....*79
Coffee tree, Kentucky....*399
Coffee Tavern, Newark-on-Trent....*294
Coffer dam, Davis Island, description of, by Wm. Martin, C.E....331
Cognac distillation, French....*60
Cohesion, nature and chemical significance of, by Fried. Mohr....192
Coke, anthracite, as a steam fuel....47
Coke breaker, improved....*360
Coke furnace, Seibel's....*381
Coke, where and how made, analyses of, and prices....414
Coking oven, Aitken's....*65
Cold air machines....252
Cold air machine, improved....*254
Cold air machines, Lightfoot's....*274
Cold, artificial, applications of in industrial chemistry, by J. W. Slater....254
Cold, bad, and sore throat, how to cure....75
Cold, catching, by Dr. Carl Seiler. A valuable paper....297
Cold cream, how to make....346
Cold in the head, quick cure for....25
Cold, production of, Cailletet's experiments.370
Cold, production of in ice machines, by Tessie du Motay and A. I. Rossi....238
Cold weather cure, by Dr. F. D. Carpenter...408
Colds, cure for....228
College, agricultural, Iowa....*189
College, science, Sir Josiah Mason's....*255
College, Yale, and Amer. paleontology....212
Collier, self-trimming, by W. Denton....*73
Collisions, prevention of at sea, Nickoll's sys. 63
Collography....225
Collodio-bromide emulsion process, by A. Mathison....131
Collodio-bromide process....19
Collodio-chloride paper....111
Collodio-chloride paper, E. Liesegang....414
Collodio-chloride process....128
Collodion, new, Boivin's....128
Collodion, rapid....97
Collodion, rapid, anti-photogenic colors, by E. Stebbing....88
Collodion transfers, enlarged....243
Collodion transfers, how to strip....216
Collodionized tissue, how to make....115
Collotype process in practice....362
Collotypes on zinc plates, by J. Husnik....168
Colognes for sick-room, recipes for....77
Color, abstract of lecture by Lord Rayleigh..134
Color and color changes, by Isidor Walz....58
Color blindness, Prof. Pole on....*204
Color comparator for quantitative analyses, by Prof. A. R. Leeds....*134
Color, curiosities of, by Henry J. Slack....340
Color designs on paper for fabrics....*331
Color harmony, by G. H. Morton, Jr....411
Color, modern theories of....354
Color, the sense of, theories regarding a gradual development of....261
Colorado River, Grand Canon of, by Capt. C. E. Dutton, U.S.A....305
Colored fires without sulphur, recipes for....121
Coloring matter derived from an impurity in commercial acetic acids, by G. Witz....276
Coloring matter, vegetable, new, by Sam. P. Sadtler and Wm. L. Rowland....292
Coloring matters, new, from benzine....232
Coloring of lantern transparencies....423
Colors, and their effects on human system....22
Colors, classification of....*170
Colors from coal tar, by George Jarmain....68
Colors of gems, blue, green, and purple, cause of, by Lt.-Col. W. A. Ross....351
Colors, popular science of, with special reference to the mixing, harmony, discord, as well as the gradual and simultaneous contrasting of colors, by Johannes Hirrienger....317
Colors, theory of, Goethe's....254
Columbia, British, its climate, resources, and people....377
Columbus, Christopher, monument to at Barcelona....*401
Column, the, considered in its historical developments and changes. Abstract of a paper by T. R. Smith, F.R.I.B.A....412
Comb foundation, hints on the use of, by S. D. Riegel....144
Combing machine, Heilmann, improved..*245
Combing machines, Imbs'....*277
Combing machines, Pierrard's....*162
Combs, gills, and hackles....*187
Combustion, generators of, chemical....253
Combustion, products of, by Thos. Wills, F.C.S. A valuable paper....139,140
Comet, Faye's, by J. R. Hind....284
Comet, great southern of 1880, by Daniel Kirkwood....260
Comets, abstract of a lecture on, by Dr. Wm. Huggins....323
Comets, by Richard A. Proctor. A valuable and interesting paper....*330, *331
Comets, facts and fancies concerning, by Prof. E. L. Larkin....343
Comets, relation of meteorites to, by Prof. H. A. Newton....172, 173
Comets, tails of, formation, by M. Faye....313
Commerce, ocean, United States, in United States built ships, by W. H. Webb....272
Comombos, ruins of the temple of, Egypt. *209
Compass, alarm, electrical, Severn's....*195
Compass, beam, Johnson's....*20
Compass, cheap, how to make....*250
Compass correction in iron ships, by Sir William Thomson....48
Compass, deviations of from 1865 to 1868, by Commander E. W. Creak, R.N....391
Compass, differential, Ile's....16
Compass needles, device for magnetizing..170
Compass, new, Sir Wm. Thomson's....68
Compass surveying, by Prof. F. E. Nipher..314
Compass, variation of in the United States.228
Compasses for drawing ellipses....*405
Compensator, signal-wire, Lyle's....*286
Compressed air, by W. H. Massey. A practical review of the principles involved in the use of compressed air as a motive power....*323
Compressed air engine, Beaumont's....238
Compressed air engine, Beaumont's....*248
Compressed air engines, by James Young. A discussion of some of the practical questions involved in connection with the application of compressed air as a motor for underground haulage in mines....*309
Compressed air for blasting, Garforth....188
Compressed air in mines, by M. G. Johnson.140
Compressed air locomotive, Beaumont's, experiments with....61
Compressed air locomotive, Schneider's*1, *2
Compressed air locomotives for tramways*357
Compressed air machines....154
Compressed air motors for street cars, an exhaustive report upon the subject to the Pneumatic Tramway Engine Co., of New York, by Gen. H. Haupt, C.E....176, 177
Compressed air receptacles....120
Compressing air, a new method of, by Jos. P. Frizell....*92
Compressing machine, improved....*394
Compressor, air, Cranston....*53
Comstock lode, interesting account of, by A. P. Schack, with vertical sections....*73
Comstock lode, by John S. Hittell....*29
Comstock mine, heat of, by J. A. Church...165
Communion cup, design for....*192
Concentrating mill for ores at O'Neil mines, Kansas....*394
Concrete, adaptation to building purposes.... 96
Concrete and iron as a building material....122
Concrete as a building material, discussion, Royal Institute of British Architects.....26, 34
Concrete buildings. Abstract of a paper by H. H. Babbage....111
Concrete cottages, designs for....*20
Concrete, dwelling house in....*119
Concrete flooring....338
Concrete floors, by A. C. Ponton....36
Concrete floors, failure of, at Cambridge....160
Concrete for embankments and dams....306
Concrete walls, how to build....183, 285
Concrete in marine construction....*387
Concrete mixer at South Pass jetties....*202
Concrete mixing machine, improved....*408
Concrete tank, the largest in England....235
Concrete walls. Method of raising an old barn and building a concrete wall under it so as to give as good a stable as if under a new structure, also method of building the driveways....183
Concrete walls, how to build....285
Concrete, walls, how to make....418
Condensation, steam, data concerning....127
Condensation, mechanical, of the liquefiable matters in gases, or vapors, new apparatus for, Pelouze & Audouin's....*57
Condenser, a new laboratory....*425
Condenser, aspirato, Koerting's....*376
Condenser discharger, Sabine's....*361
Condenser for hot vapors, Dahlgren's....*40
Condenser for engines, Honigman's....*426
Condenser for woolen yarns, Bolette's....*233
Condenser, improved, Rice's....*95
Condenser, musical, Varley's....*163
Condenser, steam, Preston's....*41
Condenser, superheater, and receiver for steam and air....*258
Condenser, surface, for street cars, Rowan's*31
Condensers, speaking, Dunand's....*350
Condenso-purifier for gas, Chevalet's....*363
Conditioning apparatus for wool....*327
Conduct, evolution of, by John Fiske....411
Conductors, electrical....425
Confectionery at home. A paper by Catherine Owen, giving directions for making various kinds of fine "French" candies....199
Confectionery, elastic mass for, recipe....392
Confectionery, non-poisonous colors for...239
Congress, the library of....254
Conifers, interesting information about....327
Coniine and compounds, by Dr. J. Schorm..311
Connecting rods, locomotive....*31
Conophallus titanum, the largest flower in the world....*167
Conservatories, designs for....*89
Conservatory, small, design for....*224
Consoles in Istrian limestone from Venice.*393
Construction, French, peculiarities of....14
Construction, mathematics of; theory of transverse strains, by R. G. Hatfield....96
Consumption, a paper by Prof. Tyndall, describing the results of Koch's investigations, 338
Consumption, crude petroleum in....242
Consumption, contagion of, by James T. Whittaker, M.D. An interesting discussion of the specificity of the tuberculous virus....243
Consumption, galloping, curability of; Dr. Anderson's treatment....77
Consumption, is it a contagious disease, and what can be done to prevent its ravages, by Dr. B. Cogshall. A brief and condensed summary of the most important testimony bearing on the question as to whether there is, or is not, a specific contagium of tubercle....297
Consumption, its causation and treatment, by Chas. G. Polk, M.D....203
Consumption, pulmon'y, mullein leaves in.387
Consumption, pulmon'y, mullein leaves in 415
Consumption, the cure of, by J. H. Salisbury, M.D. A valuable and important paper....198
Consumption, the physiognomy of....330
Consumption, tuberc. infectiveness of....349
Consumptives, open air cure for, by H. B. White, M.D....107
Constipation and its effects, by E. S. F. Arnold, M.D. An important contribution....284
Constipation, its successful cure by cascara sagrado, by F. Gundrum, M.D. Also articles on the same remedy by Drs. J. H. Bundy, W. J. Bean, S. W. Fowler, W. O. Buckland, and C. M. Galloway....164
Constipation viewed as a disease *per se*, and as an exciting cause of disease, by Robert Bell, M.D. A valuable paper....224
Contagious diseases, glandular, origin of, by Benj. W. Richardson, M.D. An important paper. 99, 100
Contagium, living, recent researches into the theory of, and their application to the prevention of certain diseases in animals, by Dr. J. L. W. Thudicum....323
Controller, electric, for trains, Brunot's..*315
Convalescent home, an English....*179
Convulsions and paralysis as effects of organic disease of the brain, by C. E. Brown-Sequard, M.D. A series of eight valuable lectures....101, 102, 103, 104, 109, 112, 119, 121
Cooke, Sir William Fothergill. Biographical sketch....191
Cookery, scientific basis of, by Prof. Mattieu Williams. An interesting and valuable paper. 426, 427
Cooking by hot water....265
Cooling appliances, Boyle's....*398
Copaiba tree of Brazil, and how the balsam is extracted....92
Copper, action of certain fatty oils upon....105
Copper alloys among the ancients. A valuable paper by Prof. E. Reyer, full of useful and interesting information....404
Copper and its alloys, determination of....147
Copper and lead, action of sea water upon....79
Copper, assay of, colorimetric method, by A. Van Bibber....414
Copper ore jigger, Hancock's....*17
Copper plate printing press, Marcilly's.*408
Copper plates, how to steel....170
Copper plates, how to steel or harden for printing....145
Copper, moss, by W. M. Hutchings....71
Copper sulphate, electrolysis, by G. Gore....339
Copper smelting without fuel, Holloway process....187
Copper, the physiological position of....84
Copper tree of Spain, and the occurrence of copper in vegetable and animal bodies....26
Copying paper, how to make....153
Copying process for letters, new....374
Coral reefs, their nature and origin, by Archibald Geikie, LL.D., Director General of the Geological Survey of G. B. A valuable and interesting paper....*427
Corinth, the new canal....*425
Cork and corks, by H. G. Glasspoole. An interesting article....185
Cork leather, how made....18
Cork making machines, Armstrong's....*34
Corks, how to bore, press, cut, and fasten.*290
Corn, beef, milk, and skim-milk, analyses of, 149
Corn, cultivation of....271
Corn culture in Massachusetts....298
Corn, fertilizers for....166
Corn, Indian, as food for man....83
Corn, Indian, microscopical examination of, by L. R. Stowell....*237
Corn silk pharmaceutical preparations, by Geo. W. Kennedy, Ph.G....389
Corn stover and hay, value of....70
Corn, white and yellow, relative values of for feeding purposes....126
Cornea, how to remove foreign bodies from, by C. R. Agnew....254
Corresponding apparatus, railway, Guggremos'....*315
Corrosion in steam boilers....104
Corrugated iron, rolling mill for making.*286
Corundum and its gems, by C. W. Jenks....61
Corundum, its varieties and uses....361
Coryanthes macrantha....*347
Corydalus cornutus.—Blister-beetles, notes on life history of.—Notes on the gall-making pemphiginæ, by Prof. C. V. Riley....152
Cosmogony of Laplace, a paper read before the American Philosophical Society by Daniel Kirkwood....210
Cosmos fiber or vegetable wool....269
Cottage, $150, design for, by S. B. Reed....*136
Cottage, English....*383
Cottage, gardener's, design for....*363
Cottage, Heaton, Mansard roof dwelling..*384
Cottage in concrete, design for....*20
Cottage villa residences and parsonage....*403
Cottages, double, design for....*407
Cottages, English, double....*288
Cottages, gardeners', Lambton Castle....*336
Cottages, hints on constructing....147
Cottages, new....*386
Cotton cords, manufacture of, improvements in, Openshaw's....*249
Cotton crop and its possibilities....248
Cotton fiber, resistance of to high temperat. 397
Cotton fibers, effects of carding and drawing processes on....*300
Cotton goods, sizing of, by W. Thompson. A valuable technical paper....80
Cotton-harvesters; with several engravings showing the construction and operation of a number of the latest machines. A valuable paper. *319
Cotton industry of India, notes on, by an Indian mill manager....340
Cotton manufacture, American, future of. The possibilities of Southern water power, by H. N. Meigs....258
Cotton mill, electric stop motion in....299
Cotton mill, the great Boott at Lowell....*221
Cotton mills, American, as viewed by an Englishman....211
Cotton mule, self-acting, Lees'....*395
Cotton opener, improved, Buckley's....*110
Cotton, origin of, by A. De Candolle....395
Cotton packing, improvements in....3
Cotton pickers, supporter for, Lynch's....*15
Cotton pickers, mechanical....*319
Cotton seed as manure....70
Cotton seed oil cake as a fertilizer and food, by Prof. W. L. Dudley....245
Cotton seed oil manufacture, its history and progress....329
Cotton stretcher, improved....*173
Cotton wood and white wood....274
Cotton worm, possible food plants for....333
Cough, why and how we do so....333
Counter, dynamometric, Megy's....*309
Counter skiving and welt machine, Tripp's...*7
Countermands and protections in the manufacturing industries....304
Countersinks, reproducing, cutting, and adjusting, machine for....*352
Country house at Battle, Eng....*354
Country house at Godden Green, Kent....*351
Country house, costing $1,750 to $2,000, design and plans for....*359
Country residence, design for....*361
Coupling, sleeve, expansion, Goubet's....*280
Coupling, sleeve, Goubet's....*279
Coupling, sleeve, Verity's....*337
Couplings, flexible, for screw shafts....*245
Couplings, shafting, and hangers....*205
Court House and Post Office, Peoria, Ill....*411
Cow, good, outward marks of, by J. C. Morris, 135
Cow, how long to milk....30
Cow, Jersey, a wonderful....260
Cow milking apparatus, by W. Blurton....*147
Cow, Short-horn, Juno....*98
Cows, abortion in, by Prof. L. Frank....131
Cows, Guernsey, characteristics of....*350
Cows, milch, value of roots for....262
Cradle for proposed Panama ship railway.*196
Cramp, writer's, and allied affections, their pathology and treatment, by Geo. M. Beard, M.D. A valuable paper....177
Cranberry culture, by J. Edward Wing....143
Cranberries, how to cultivate....321
Cranberries in the garden, how to raise....222
Cranberries, practical directions for the culture, harvesting, cleaning, and drying of....191
Crane, hydraulic, 160-ton, Armstrong's....*20
Crane, locomotive, Black, Hawthorn & Co.'s.*54
Crane, traveling, Sampson, Moore & Co.'s..*53
Crane, portable, for piling up casks....*334
Crane, railway, locomotive, Dubs'....*84
Crane, steam, locomotive....*244
Crane, steam, portable, Brown Bros.'....*59
Crane, traveling, portable, Russian....*42
Crane, traveling, 15-ton, improved....*312
Crane, 160-ton, of Creusot works....*129
Crank, broken, repaired with wire rope...*287
Crank shaft, dead centers in, device for suppressing....*359
Crank shaft of S.S. Colima, repaired at sea..*31
Crank shaft of the U. S. steamer Trenton...*27
Cranks, how to place upon a shaft at right angles, by Joshua Rose. A valuable paper.*23
Cream of tartar, notes on, by A. H. Allen...237
Cream separator, centrifugal, Laval's....*263
Cream tartar, new method of manufacture, by J. W. Haas....13
Cremation in Italy, descriptions of the crematories recently established in Milan, by A. B. Archbald....262
Crematory furnaces, Siemens'....*264
Creosote, its tests and action, by M. Hager.—Therapeutical value, chemical tests of....368
Crevaux, Dr., South American explorer. Sketch of his travels, with portrait....*364
Cricket pavilion, Oxford University....*297
Cross raising machine, cloth....*162
Crossheads for locomotives, Borsig's....*82
Croton chloral in whooping cough....67

Croup and diphtheria, the distinctions between, by Dr. W. H. Day....210
Crow, American, habits of....*385
Crucible, furnace, repair of, while in blast...34
Crucibles, platinum, how to mend....142
Crushing mill for malt, etc., improved....*402
Crustacean, gigantic deep-sea....*169
Crustaceans, hermaphroditism in....393
Cryolite and its uses....81
Crystal Palace, French....*303
Crystallization table, by Messrs. Finot & Bertrand, showing the point at which the evaporation of certain solutions is to be interrupted to procure a good crop of crystals on cooling..303
Crystals. A clear and concise essay on crystallography for the use of students....176
Crystals, angles of, measurement of, with the goniometer....*30
Crystals, drying machine for....*77
Crystals, microscopic, photography of for lantern slides....60
Crystals, snow, how to reproduce the forms of artificially....*33
Crystals, study of, by J. H. Collins, F.C.S. *126
Cuba, trade relations of, with the United States, and present condition, by G. W. Roosevelt...296
Cultivator, steam, Garrett's, for beet root culture....*374
Culture under glass made easy....13
Cunard fleet, history of the organization of. 3
Curare and other cures for hydrophobia....230
Curator's lodge, Botanic Gardens, Catabridge, England....*296
Currant worm, black ants as a protection....316
Currant worms, how to get rid of....242
Currants for profit....183
Current measurer, Deprez's....*265
Currents, induced, some luminous effects of. An account of some experiments by Mr. Conion on the movements of electricity in highly rarefied gases....*238
Currents produced by friction between conducting substances, and on a new form of telephone receiver, by James Blyth....246
Cursometer, apparatus for measuring the speed of railway trains....*372
Curves, instrument for tracing....*345
Cushions, air, dock, Clark & Stanfield....*84
Cushions, horsehair, how to stuff....*291
Cut off, steam, Sickles'....45
Cutting tools for lathes and planers, by Joshua Rose. A valuable paper....*38
Cuttings, theory of the growth of. Abstract of a paper by Charles Darwin....271
Cyanotype process....95
Cyclograph, Worthington's....*245
Cyclone, Western, a remarkable....414
Cylinders of soft iron, magnetism of, influence of form on....75
Cylindrold ships....*218
Cypripedium niveum and C. concolor....*377
Cyprus, soil, climate, and natural products. *146

D

Daguerreotypes, how to clean....89
Dairy cottage, design for....*170
Dairy progress, American, some statistics of. 157
Daisy, ox eye, how to exterminate....132
Dam across the Ottawa river, and canal at Carillon, with general, sectional, and plan views, and statistics of work, by Andrew Bell....*384
Dam, coffer, Davis Island....337
Dam, Davis Island, Pittsburg....195
Dam, Gileppe River, general description, with perspective view of the dam and reservoir, plan view, and section of masonry....*403
Dam, movable, new system of, with swinging wickets and trestles, Lyons, France....*264
Damascened ornaments from a shield....*120
Damping machine for textiles, Fromm's..*331
Dams, movable, of various systems....79
Danube River, straightening the course of. *20
Dark room windows, flexible tissue for....372
Darwin and Darwinism, Prof. Haeckel on...358
Darwin, Charles, his life, with portrait....*337
Darwin, gossip about....423
David Sassoon building, Bombay....*300
Davy, Sir Humphry. Biographical sketch...169
Dead animals, utilization of as fertilizers....83
Dead centers in cranks, devices for suppressing. Raffard's....*359
Deaf and Dumb Institution, Washington....*46
Deafness, cold as a cause of, by Dr. Griffin..265
Deafness in schools, Dr. Sexton on....325
Deafness, temporary. A clinical lecture, by H. A. Wilson, M.D., dealing with that form of the complaint due to impacted cerumen....264
Death, painless....176
Death bed studies....93
Decalsne, Joseph, the botanist. Biographical sketch of....327
Decanter, how to lift with a straw....*247
Deciplum, metal, by Mr. Delafontaine....155
Declinometer, Brunner's....*386
Decorations and furniture, designed by F. Wirth's Sons....*326
Decorative details from the Exhibition Palace, Paris....*155
Decorative painting, ornaments for....*202
Deer, the milu, of China....*188
Deers' antlers, metamorphosis of, by Karl Brandt. *344
Defense, national, an address by Sir W. G. Armstrong....322
Deities, chief, in the religion of the American Indians, by A. S. Gatschet....361
Delesse, Achille, the mineralogist and engineer. Biographical sketch of....299
De Lesseps, Ferdinand, and family....*270
Demagnetization, rapid, new method for, by J. Trowbridge and W. N. Hill....419
Densimeter, sugar, Huchs'....*161
Dental departure, new, in using amalgam fillings, by L. P. Meredith, M.D....138
Dental rubber, how made....252
Dentition, by Richard A. F. Penrose, M.D. A very instructive lecture delivered before the medical class of the University of Pennsylvania, upon a subject of vital importance to the welfare of the infant in health and disease....167
Depots of the Hudson River Railroad....253
Depth gauge, navigational, application to of a septum permeable to water and impermeable to air, by Sir William Thomson....*265
Derrick, hand, 30 foot, cheap and easily constructed, by T. Appleton....*380
Derrick, railway car, Vorug's....*125
Derrick used at Davis Island dam, by James Harlow, C. E....225
Desiccating case for chemical laboratory *332
Desk, knapsack, and bed, combined....*369
Desman....*184
Details from St. Albans....*245
Detecter, watchman's, electric....*315
Developer, carbonate of soda....65
Developer for dry plates, new....192
Developer, ferrous-oxalo-citrate, by W. De W. Abney....310
Developer, lactate of ferrous oxide....226
Developer, new, by W. T. Wilkinson....340
Developer, new, for dry plates, by L. O. Sammann....61
Developers, alkaline, strong, notes on....196
Developers for gelatine plates, improved, by Dr. Eder....415
Devil beans of Mexico, and their singular movements, by J. W. A. Wright....*106
Devioscope, an apparatus for giving directly the relation that exists between the angular velocity of the earth and that of any horizon whatever around the vertical of the place, by Geo. Sire....*290
Dextrine and starch, detection of, by S. U. Pickering....270
Dextrine maltose, or malt sugar, and its use in brewing, by Prof. Wm. George Valentine, F.R.S. An exhaustive and able paper, containing the most recent and reliable information on these substances....19, 22, 25, 28
Dextrine, uses of in photography....51
Diabetes mellitus, by J. H. Salisbury. A valuable paper, pointing out drinks and food that must be used, exercise that must be taken, clothing that must be worn, and remedies that must be used to cure this disease....207
Diabetes mellitus, treatment of, with salicylate of soda....113
Diabetes, points connected with, by F. W. Pavy, M.D....142
Diabetes, skimmed milk in....125
Dial, self-recording, for miners....*39
Dialysis, continuous, Lebaigue's....*168
Diamond, action of in ruling lines on glass, as shown by the microscope....412
Diamond, artificial production of, by N. S. Maskelyne....214
Diamond field of South Africa....392
Diamond fields of Griqualand, South Africa, by J. B. Currey....18
Diamond, how formed, by A. B. Griffiths..354
Diamond, origin, artificial production and uses of, by Henry A. Mott, Jr., Ph.D. An interesting paper....218
Diamonds and other precious stones, whence derived, comparative values, and other interesting information concerning....104
Diamonds, artificial production of, by Mr. Jas. Mactear....216
Dianemoscope, Stanek's, for analyzing the complicated motions of a double slide-valve system....*84
Diaphragm, diseases of....151
Diarrhœa, carbolic acid in....92
Diarrhœa, causes and treatment of....197
Diarrhœa in children, a simple treatment...155
Diarrhœa, oxide of zinc for....81
Diatoms, structure of....*41
Dictionary of terms used in the manufacture of carriages....396
Dielectric machine, new, Le Dantec's...*245
Diet, errors in, by Dr. Wilson. A valuable paper. 94
Dietheroscope, Lurim's, an instrument for measuring variations in the refractive condition of the atmosphere....* 30
Differential wheels, new form of, by Prof. C. W. MacCord....*134
Diffusion, continuous, apparatus for....*258
Diffusion, continuous, apparatus for, Largilliere's....*314
Digestion and dyspepsia....199
Digestion and the use of artificial digestive agents. A paper by Dr. J. M. Fothergill explaining the process of digestion and the *rationale* and utility of artificial digestive agents, and what is aimed at in resorting to them. Illustrated with a diagram of the digestive tract....*314
Digging machine, steam, Darby's....*154
Digging machine, steam, Knight's....*29
Dingy, duplex, Berthon, a form of dingy that can be carried by torpedo launches....*240
Dinosaurs of the Rocky Mountains....174
Dioscorea retusa....*388
Dip circle, simple, Goolden's....*371
Diphenyl, ready method of preparing....*187
Diptera as spreaders of disease. A paper by J. W. Slater suggesting the probability of all infectious diseases being at times propagated by flies....303
Diphtheria and cellars, by Dr. A. G. Field. Topographical observations of twenty impartially selected residence sites in which diphtheria occurred during the summer of 1875, and deductions therefrom....3
Diphtheria and croup, the distinctions between, by Dr. W. H. Day....210
Diphtheria and its treatment, by Dr. C. E. Billington....38
Diphtheria, by W. N. Thursfield, M.D....150
Diphtheria, Brooklyn treatment of, by Paul K. Kretzschmar, M.D....191
Diphtheria, cause of....107
Diphtheria, cause of, in the family of S. Crump, Esq., Montclair, N. J., by Dr. J. W. Pinkham, 270
Diphtheria caused by bad sewerage. Abstract of a paper by Dr. W. Scrively....*142
Diphtheria caused by milk....210
Diphtheria, clinical study of....56
Diphtheria, iodine treatment of....307
Diphtheria, mercurial fumigations in, by J. Corbin, M.D. Brief history of certain cases of laryngeal diphtheria that were successfully treated by the author with fumigations of black oxide of mercury....297
Diphtheria, period of life most liable to suffer from....142
Diphtheria, pilocarpin in, Dr. Muller....314
Diphtheria, prevention of, by Dr. E. R. Maxson. A paper of great interest and value to physicians and parents, giving the history and pathology of the disease and offering suggestions as to how it may be prevented and finally exterminated....281
Diphtheria, successful treatment of, by Dr. E. Cheney....50
Diphtheria, successful treatment of, by Dr. J. J. O'Dea....369
Diphtheria, treatment of, by Dr. J. H. Nowlin. A valuable paper....51
Diphtheria, treatm't of, by Dr. L. Weigert. 125
Diphtheria, treatment of, with carbolized camphor....249
Diphtheria, treatment of, with iodoform. 373
Disease in the human body, nature, origin, and progress of, by J. B. Graves, M.D....124
Disease, physical signs of, derivable from the breath, lips, teeth, and mouth, by G. V. Poore, M.D. A valuable paper....242
Disease, some thoughts on the treatment of, by James G. Clark, M.D....216
Diseases, contagious, affecting the lower animals, danger from, by Prof. Stalker....252
Diseases, contagious, and their prevention, by A. J. Jessup, M.D....143
Diseases, contagious, glandular origin of, by Dr. B. W. Richardson. Important paper...99, 100
Diseases, constitutional, cure of, by the use of glasses, by D. B. St. John Roosa, M.D....252
Diseases, filth and semi-filth, by Dr. John C. Peters....294
Diseases, filth, in rural districts, by Dr. A. L. Carroll....404
Diseases, infectious, a practical method for preventing the spread of in households, by Dr. Malcolm McLean....320
Diseases of domestic animals, report on, by Prof. James Law. A valuable paper....243
Diseases, specific, relation of minute organisms to, by Prof. Klebs....303
Diseases, uncommon, in Peru and Bolivia, by E. R. Heath, M.D....396
Diseases, virulent, and especially on the disease commonly called Chicken Cholera, by L. Pasteur....242
Disinfectant, black oxide of manganese as. 82
Disinfectant, sulphurous acid as, by T. W. Keates....58
Disinfectants and their special applications. A valuable paper, by Dr. E. L. Griffin, showing how to use various disinfectants....162
Disinfectants. Experiments to test the value of certain gaseous and volatile disinfectants, by George W. Sternberg, U.S.A....217
Disinfection by nitrous oxide....*291
Disinfection, hospital, apparatus for....*262
Disinfection, instructions for, prepared by Nat. Board of Health....197
Disinfection of the atmosphere....417
Disinfecting apparatus, automatic....*227
Disinfecting chamber, portable, Lyons'..*416
Disintegrator, improved, Carter Bros.'....*15
Displacement, continuous, apparatus for, Wiegelt's....*292
Distances and heights, inaccessible, methods of measuring, by T. E. Candler....*313
Distillation, cognac, French....*60
Distillation, continuous, apparatus, Egrot's, *252
Distillation, destructive, by Owen Merriman. An explanation of some of the reactions that are involved in the distillation of coal....306
Distillation, fractional, under pressure, new apparatus for, by E. J. Bevan....*130
Distillation, gas, Farcot's furnace for...*226
Distillation, gas, Herwood & Barron's apparatus for....*292
Distillation of essential oils, Heywood & Normandy's....*399
Distillation of salt water, apparatus for, Normandy's....*399
Distillation of shale and other minerals, retorts for, Bennie's....*57
Distillation, Savelle's system of....*60
Distillation, solar, of salt water, apparat*405
Distillation, solar, Remington's....*110
Distillatory apparatus, Remington's....*110
Distilleries, tar, how to extinguish fires in, by Watson Smith, F.C.S....181
Distilling apparatus for ammoniacal liquor, Feldmann's....*416
Distilling apparatus for beet root molasses residua....*376
Distilling apparatus for sea water....*234
Distilling apparatus, Japanese....*292
Distilling apparatus, locomotive, Joya...*316
Distilling apparatus, Solvay's, for the concentration of gas liquor from gas works, by Dr. G. T. Gerlach....*316
Distilling apparatus, stationary and portable, Egrot's....*77
Divers, electric signal for....*353
Dividing engines, and the methods of making accurate linear scales, by A. M. Mayer...*93
Diving apparatus, an improvised....*80
Diving apparatus, Fleuss, by B. W. Richardson, M.D....*123
Diving armor and appliances for working in irrespirable gases, by W. A. Gorman....*242
Diving bell used in constructing Pola dock.*341
Diving dress, Fleuss, new, by means of which a diver is enabled to remain under water for several hours....*197
Division, new rule for....*230
Dobby machine, Ainsworth's....421
Dock, Avonmouth, Bristol, Eng....*245
Dock, depositing, new, at Barrow, England. General description, with plans, elevations, and sections....*71
Dock, floating and depositing, Nicolaieff, for raising vessels out of water and depositing them high and dry on fixed stages of open pile-work, by L. Clark, C.E....*295
Dock, floating, at St. Nazaire, France. Full description, illustrated with figures showing plans, sections, and details....*25
Dock, floating pontoon, Turnbull's....*376
Dock, floating, Lauria's....*275
Dock, graving, new, at Port Lyttleton, New Zealand; with description of harbor improvements....95
Dock, Royal Albert. General description of the work, with map and sectional plans....*387
Dock, Victoria, extension of....*241
Dock, Victoria, extension of....*34, 46
Dockage, new, New York. Particulars of construction....*123
Dockage system, tubular floating, Clark & Stanfield's....*23
Docks, air-cushions for, Clark & Stanfield's.*42
Docks, dry, new, at Erie Basin, Brooklyn....*84
Docks, new, at Milford....314
Docks, new, port of Dunkirk....*262
Dog, poodle, German corded....*246
Dog show at Berlin....*244
Dogs. Eleven figures of prize animals at the Belgium International Dog Show....*310
Dogs, rabies in, its origin and symptoms....114
Domestic animals, gestation of....246
Don Cossack, the race horse....*273
Donkey cart, design for....*268
Door panels for iron stoves, carved patterns for, by Ihne & Stegmuller....*63
Doors, water-tight, for ships....*151
Doorway, ornamental, by Myskovszky....*59
Doorway top in iron, 16th century work..*247
Door-yards, how to keep green....291
Dore, Gustave, biog., with portrait....*375
Dotting machine for tulles....*303
Dovetail, and dovetail tools....*195
Dovetailing and mould'g mach., Anderson*347
Drain pipes, back pressure in....*425
Drain pipes, socketed, machine for making, Whitehead's....*66
Drainage, house, how to deal with....421
Drainage and sewerage of cities, a paper by Col. Geo. E. Waring, C.E....226
Drainage, country house, by J. C. Bayles..61
Drainage, house. A valuable paper....*194
Drainage, house, E. S. Philbrick..*242, *243
Drainage, house, disposal of, by E. S. Philbrick. A valuable paper....308
Drainage of an apartment house....*166
Drainage problem at Hoboken, N. J....299
Drainage, sewerage and ventilation of houses, by R. Middleton....272
Drains, house, common defects in, by E. C. Clarke, C.E. A valuable paper....*179
Drains, how to lay, by T. M. Reade, C.E....85
Draper, Dr. Henry. Biographical sketch of, by Charles A. Young, with portrait....*379
Draper, Henry. Biographical sketch of....375
Drawbridge, proposed, for the Thames, London, by Frederic Barnett....*19
Drawing, aids to the art of. Figures and description of various easily-made apparatus for enabling amateurs to reproduce correct outlines of objects with ease and rapidity....*158
Drawing, aphorisms on, by Mr. Ruskin....105
Drawing apparatus, electric....*197
Drawing arcs of circles of large radius, apparatus for....*285
Drawing, carriage, perspective....*267
Drawing converging straight lines, instrument for....*363
Drawing instrument, new, by C. W. MacCord. *424
Drawing, mechanical, by Prof. C. W. MacCord, of the Stevens Institute of Technology. A series of new, original, and practical lessons in mechanical drawing, accompanied by carefully prepared examples for practice, with directions, all of simple and plain character, intended to enable any person, young or old, skilled or unskilled, to acquire the art of drawing. No expensive instruments are involved. The series embodies the most abundant illustrations for all descriptions of drawing, and forms the most valuable treatise upon the subject ever published, *as well as the cheapest.* The series is illustrated by upward of 450 special engravings, and forms a large quarto book of over one hundred pages, uniform in size with the SCIENTIFIC AMERICAN. Price, stitched in paper, $2.50. Bound in handsome stiff covers, $3.50. Sent by mail to any address on receipt of price. Address Munn & Co., Publishers, 361 Broadway, New York. Office of the SCIENTIFIC AMERICAN.

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Drawing, mechanical, how to do sectional shading in....*112
Drawing-room corner and octagon boudoir, *268
Drawings, mechanical, a new method of keeping, by C. T. Porter....312
Drawings, pseudo-perspective, for illustrating mechanical objects, by Robert Briggs....*17
Dredge, "Ingurgitator," Dennison's....*94
Dredger for canals, Rennie's....*283
Dredger, improved, Bruce & Batho's....*289
Dredger, one-ton bucket, improved....*358
Dredger, single-bucket dipper, Rennie's...*299
Dredger, steam, Hopper's....*169
Dredger, steam, twin-screw, new....*193
Dredger, tug, and fire engine....*209
Dredger, tug and fire engine, Batho's....*204
Dredging and mining machine, hydraulic, Newton's....*100
Dredging, Bazin system of, by A. A. Langley. *324
Dredging machinery, Lake Fucino, Italy...*8
Dredging or excavating mach., Kinipple's.*100
Dress, Rational, Exhibition....*393
Dressing machine, millstone, Dupety's....*182
Drier, steam, Bachmann's....*363
Drier, tobacco, Chapin's....*8
Drill, Diamond, the Pennsylvania Drill Co.'s.*32
Drill, radial, boiler plate, Beesley's....*324
Drill, rock, Barlow & Co.'s....*49
Drill, rock, Burleigh....*48
Drill, rock, Kainotoman....*23
Drill, rock, Sachs'....*263
Drill, vertical, by F. G. Woodward....*53
Drilling and slotting machine, Lowery's....*16
Drilling machine, boiler, Bowker's....*258
Drilling machine for boiler-shell....*66
Drilling machine, portable, for rivet holes, Borland's....*407
Drilling machine, radial, Asquith's....*85
Drilling machine, radial, Warren's....*399
Drilling machinery, rock, by J. Darlington*103
Drilling machines, Bement & Son's....*37
Drills and drilling, instructions about....*311
Drills, rock, submarine, by E. Moore....*56
Drinking-water, by Dr. N. B. Sizer....346
Drinking-water, how to test the quality of. 147
Drinking-water, organic matter in....114
Drinks, stimulating, a paper descriptive of many different kinds....236
Drive-well in England....*107
Drive-wells for large water supplies, by Robert Sutcliff....*110
Driven well system, Brooklyn....*419
Driving band, Scandinavian. Description of a new form of machine belting of Swedish origin....239
Drop-light, Taylor's....*86
Drop-shutter, new....*171
Drops, forms of as studied by means of an electric spark, by A. M. Worthington....*86
Drowned, resuscitation of the....351
Drowned, treatment of. A series of valuable directions, showing how to restore to consciousness persons that have been drowned, those that have been suffocated by smoke or poisonous gases, and those in whom breathing has been temporarily suspended through hanging or the effects of chloroform, etc....*201
Drugs, adulteration of in America, by Fred. Stearns....330
Drugs, adulteration of in England....333
Dry-dock and dockage system, Clark and Stanfield's....*42
Dry plate photography, patience in....124
Dry plate, process, Andrieux's....151
Dry plates, rapid....229
Drying apparatus for pasteboard....*314
Drying apparatus for wool, Bolette's....*161
Drying apparatus for wool, Lohren's....*207
Drying apparatus, hot air, Redfern's....*64
Drying apparatus, Levicel's....*425
Drying box for photogelatine plates....*187
Drying cupboard, Cowan's....*202
Drying machine for crystals....*77
Drying stove for printed sheets, Renault's.*304
Dry-rot in wood, Schwartze's preservative against....74
Duckbill, Australian, by G. A. Stockwell...398
Ducks, eider, at the Berlin Fisheries Exhibition. *242
Dugong, the, of Queensland....426
Du Motay, Cyprien M. Tessie. A critical review of his life and scientific labors, by A. J. Rossi. 266
Dumping, hydraulic....153
Dunkirk, France, port of....*262
Duprez, Marcel. Biographical sketch, with portrait....*389
Dust as an explosive....125
Dust, combustible, explosions from, by Prof. L. W. Peck. An interesting paper demonstrating the fact that all combustible material when finely divided, so as to form a dust or powder, will, under proper conditions, burn with explosive rapidity....*166
Dust of streets, analysis of....107
Dust showers, microscopic examination of. *199
Dusts, dangerous properties of, by F. A. Abel. Combustibility of dust, explosion in mills, cause and prevention, effect of coal dust in mines, coal dust the chief agent of destruction in mine explosions. A valuable paper....374, 375
Dwarf, an extraordinary....*284
Dwarfs and giants....*255
Dwelling, design for....*109
Dwelling house in concrete....*119
Dwellings for artisans, Hornsey....*415
Dwellings for artisans and laborers, England. *420
Dyaks of Borneo....*188
Dye colors of fabrics, tests for....187
Dye, new, alizarine carmine, and recipes for its use....147
Dyeing and printing, artificial purpurine in, by M. A. Duffy....142
Dyeing and printing, electricity in, by F. Goppelshroeder....352
Dyeing aniline black by aid of vanadium...245
Dyeing, bleaching, printing, etc., by Ch. Weidinger....149
Dyeing feathers, numerous recipes for....269
Dyeing felt, recipes for....90
Dyeing, fire risks of....376
Dyeing, fixation of indigo upon cotton, by Schlieper and Baum....403
Dyeing, history and art of....107
Dyeing leather, by W. Eitner....72
Dyeing leather, colors and shades applicable to, by E. N. Beller....405
Dyeing of garments, notes on....80
Dyeing, practical recipes for....169
Dyeing recipes, a valuable collection for different shades....7
Dyeing recipes for fast shades in wool....249
Dyeing recipes for linen, cotton and wool. A valuable collection....38
Dyeing recipes for various shades....25
Dyeing recipes for wool, leather, cloth and linen....35
Dyeing recipes. Formulæ for 11 different kinds of dyes used in Europe....231
Dyeing recipes, practical, valuable collection. 13
Dyeing, silk, by Marius Moyret....181
Dyeing skins....111
Dyeing, Turkey red....390
Dyeing, useful recipes for....59
Dyeing, various practical recipes for....277
Dyeing, washing, or sizing machine for yarn in hanks....*111
Dyeing wool (see Wool dyeing).
Dyeing, 220 recipes from practical dyers....167
Dyes and colors, 13 recipes for....131
Dyes, "azo," composition of....246
Dyes, azo, and naphthol....234
Dyes, brown, with wood extracts, practical recipes for....90
Dyes, coal tar, manufacture of....*341
Dyes, coal tar, manufacture of and the preparation of nitrobenzol and aniline....*343
Dyes for cloth and yarn, recipes for....182
Dyes for gloves....108
Dyes for jute: red, light green, brown, and reddish brown....260
Dyes for wool, recipes....163
Dyes, garnet, how to prepare....85
Dyes, new mordant for fixing....89

Dyes on yarns and tissues, new method of detecting, by Jules Joffre....363
Dyes, various shades, recipes for....53
Dyestuffs, manufacture, properties, etc....134
Dyewood, new, Beth-a-barra....292
Dynagraph, Johnson's, for ascertaining resistances of engines and cars....9
Dynamics, radio, by Pliny Earle Chase....294
Dynamite in agriculture....134
Dynamo electric machines (see Electric machin's.)
Dynamo machine, with friction-gear....*419
Dynamometer, Ayrton and Perry's....*372
Dynamometer, balance, Farcot's....*215
Dynamometer, current, Sabine's....*387
Dynamometer, flexible band, new form of, by Prof. W. C. Unwin....*415
Dynamometer for currents of great intensity, Weber's....*250
Dynamometer for measuring the strength of fabrics, Hausner's....*78
Dynamometer, hydrostatic, Peltat's....*399
Dynamometer, improved, Tatham's....*320
Dynamometer, magnetic, Saya's....*314
Dynamometer, new, for measuring the power delivered to screws of ships, Wm. Froude..*89
Dynamometer, rotary, Morin's....*194
Dynamometer, Smith's....*309, *314
Dynamometer, totalizing, Megy's....*376
Dynamometer, transmission, Thomson's..*272
Dynamometric brakes, new....*264
Dynamometric counter, Megy's....*309
Dysentery, corrosive sublimate in, by Dr. Chas. H. Hall....122
Dyspepsia among farmers, cause of, by Dr. S. Baruch....323
Dyspepsia and digestion....199
Dyspepsia, by Dr. A. Leared....190
Dyspepsia, its causes, symptoms, and treatment, by Dr. C. F. Kunze....129
Dyspepsia, remedy for....240
Dyspepsia, treatment of....162
Dyspepsia, washing out the stomach a cure for. A valuable clinical lecture, by J. M. Da Costa, M.D....215
Dyspepsia, relation of to constitutional diseases, by Dr. J. Cornilion....132, 133

E

Eads, James B. Biographical sketch of....44
Eagles of poetry and prose, by Ed. Newman. 68
Ear, action of quinine and salicylic acid on...333
Ear disease, treatm't of, by Dr. J. L. Minor..333
Ear, diseases of, by Dr. Samuel Theobald. Successful treatment of several cases of fungoid disease with zinc oxide and boracic acid....294
Ear, diseases of, from bathing....138
Ear, aspergillus in, by C. H. Burnett, M.D..*208
Ear, wearing of cotton pellets in as artificial drum-heads, by C. H. Burnett, M.D....217
Ears, the cerebral symptoms by impacted cerumen in, by W. A. Hammond, M.D....166
Earth, actual figure of, by Dr. G. W. Rachel..266
Earth, age of, Proctor on....218
Earth, arable, what it is made of, how formed, and how improved, by Stanislaus Meunier.. *28
Earth as a conductor of electricity, by John Trowbridge....245
Earth as seen from other stars....*252
Earth, growth of, by Prof. C. A. Young....40
Earth, immobility of, by Dr. Schoepper....*121
Earth, inner, nature of....180
Earth, interior density and construction of, by D. P. Blackstone. An interesting paper....90
Earth, interior of, by Sir Geo. B. Airy....129
Earth, internal heat of, by Prof. Mohr....11
Earth, magnetism of, effect upon of the sun's rotation and the moon's revolution....17
Earth movements in Java, by R. Proctor....416
Earth, rotation of as a driving power....102
Earth, rotation of, demonstrated by the gyroscope, by J. M. Arnold....*197
Earth, Sir Wm. Thomson's arguments for the age of, note on....86
Earth tremors....314
Earth tremors, report of committee to British Association, 1882....356
Earth worms, harm done by, by F. H. Storer..322
Earth worms, what they are good for....103
Earthquake waves....414
Earthquakes in 1878....201
Earthworm, a new....386
Eastgate House, Rochester, Eng....*308
Ebonite....252
Ebonite, index of refraction, measurement of, by Profs. Ayrton and Perry....*289
Ebullioscope, or apparatus for ascertaining the proportions of alcohol present in liquids, Malligand's....*17
Eccentricity and idiosyncrasy, by Dr. Wm. A. Hammond....358
Echoes, aerial, by Prof. Joseph Henry....153
Eclipse of 1878, by Prof. C. A. Young....140
Eclipse, solar, Dec. 1880, by J. R. Capron..*289
Eclipse, solar, of 1878, report on by J. Norman Lockyer and Prof. Henry Draper....*144
Eclipse, solar, of 1878, Dr. Draper's obs....141
Ecclesiastical Art Exhibition, building..*225
Eddystone lighthouse, new....*419
Edison, Thomas Alva. Biog., with portrait..*309
Education, industrial, a new feature in. A description of the new system of hand education adopted by the Society for Ethical Culture in the instruction of children in the principles underlying all mechanical arts and occupations..*230
Education, Prof. Huxley on....381
Education in the United States....347
Education, relations of labor, Johannot....97
Education, scientific, Huxley on....257
Education, the Quincy methods in, by Prof. G. B. Northrop....268
Edwardsia grandiflora....*396
Eels. Their natural history, the mode of taking them, and many other interesting details..266
Eels, Delaware....239
Eels, reproduction of....171
Egg and poultry trade, Europe and U.S....373
Eggs, fresh, how to have the year round....145
Eggs, how to ascertain the age of....316
Eggs, how to feed hens for....166
Eggs, how to preserve....101
Eggs, how to preserve for the market....317
Eggs, how to preserve with paraffin....308
Eggs, profits on and nutritive value of....53
Eggs, simple method of preserving....65
Egyptian antiquities. An interesting narrative of a tour of the River Nile, with descriptions of the more interesting localities and their monuments....*273
Egyptian remains, Brugsch's discovery..*307
Electric alarm....*381
Electric apparatus, measuring, at Munich.*421
Electric apparatus, thermo, Ridout's....*238
Electric arc, new experiments with....348
Electric arc, reaction current of....347, 378
Electric balloon, Tissandier's....*416
Electric batteries, cost of....420
Electric battery, Camacho's....*47
Electric battery lights for railway trains....417
Electric bell and battery....*369
Electric bell, De Redou's....*382
Electric bell, Lippens'....*388
Electric bells, suppression of piles in....*412
Electric bleaching of textile fibers....*401
Electric brake, Achard's....*312
Electric cables, underground, improved method of laying....*390
Electric candle, solenoid, Morin's....*400
Electric chandelier....*326
Electric chronograph for steam boilers, Lethullier's....*173
Electric cigar lighter, Edison's....*411
Electric clock chimes....*44
Electric coast warning, Perry's....*283
Electric compensator applied to the Prony brake. *359
Electric conductors, lead-cased, manufacture of. *386
Electric current, application of in analytical chemistry, by C. Luckow....233
Electric current, dynamo, new applications of in metallurgy and in horticulture....*242
Electric current, force of, variation in by the action of sonorous vibration, by Prof. D. E. Hughes....*127
Electric current measurer, Deprez's....*265
Electric current meters, Shaw's; and method of taking sub-surface observations....*414
Electric currents of high tension, experiments on, by M. Gaston Planté....*111
Electric currents, what are they? Abstract of a lecture by Prof. Silvanus Thompson....334
Electric detecter, McEvoy's, for ascertaining the presence of metals under water....*357
Electric discharge in gases....245
Electric discharge through colza oil, by Dr. A. Macfarlane....308
Electric discharge, Mayer's apparatus for analyzing....*168
Electric discharges, arborescent, obtained from the rheostatic machine....*207
Electric discharges in rarefied gases, experiments of De la Rue and Müller, on....188
Electric drawing apparatus....*197
Electric earth currents, apparatus for automatically registering....*413
Electric engraving machine....*153
Electric exploding apparatus for mining purposes....*319
Electric eel....*236
Electric fire-damp detecter, Forbes'....*200
Electric flash-signaling apparatus for lighthouses, railways, etc., Peebles'....*81
Electric free-pendulum regulator for communicating time to all the clocks of a city....*153
Electric gas lighter, Bogart's....*44
Electric gas lighter, Gaiffe's....*29
Electric gas lighting apparatus....*213
Electric gas pressure regulators, systems of Launay and of Chardin....*214
Electric gauge, Mercadier's....*329
Electric generator, magneto, De Rouilly's. *352
Electric generator, secondary, Gaulard-Gibbs. *387
Electric generators, dynamo-engine for driving. *327
Electric gyroscope, magneto....*233
Electric harmonica, Somzee's....*342
Electric hoist, Hopkinson's....*318
Electric incubator....*425
Electric induction, coil-regulator for, by J. E. Floyd....*152
Electric induction, volta, by Willoughby Smith. *417
Electric lamp, arc, Abdank's, by W. H. Preece. *360
Electric lamp, incandescent, for miners, Planté's. *414
Electric lamp, Mondos'....*362
Electric lamp, Higgins'....*185
Electric lamp, incandescent, Reynier's....*208
Electric lamp, Jamin's....*194
Electric lamp regulator, Somzee's....*342
Electric lamp, Solignac's, by Th. Du Moncel. *362
Electric lamp, Stewart's....*231
Electric lamp, Strode & Co.'s....*263
Electric lamp, sun, Clerc and Bureau's....*313
Electric lamp, Werdermann's....*217
Electric lamps, arc and incandescent, being a description with engravings of all the principal forms of electric lights now used; with thirty engravings....*162
Electric lamps, brief descriptions of the various kinds....157
Electric lamps, Hedge's....*315
Electric lamps, incandescent, Trouve's....*370
Electric lamps in Paris, by Prof. Silliman. 142, 143
Electric light, a lecture by Henry Morton.*151
Electric light apparatus for photography..*312
Electric light and gas apparatus, exhibition at Glasgow....259
Electric light apparatus for photographic purposes, by A. J. Jarman....*312
Electric light apparatus, simple, by Geo. M. Hopkins. Two full-size working drawings of easily made apparatus, and three drawings showing all details of cells and how to arrange in battery, with full instructions....*149
Electric light, application of in theaters....*410
Electric light, application of to submarine construction, by C. C. Soulages....*350
Electric light, arc, by Leo Doft....315
Electric light arc lamp, "Pilsen," by H. F. Joel. *339
Electric light at Moscow during the coronation of the Czar....*412
Electric light at the Angers (France) State quarries....*271
Electric light, carbon points for, by F. Carre..98
Electric light carbons, machine to make, Cunliffe's....*417
Electric light, divisibility of, by W. Trant...158
Electric light, economy of, by W. H. Preece..288
Electric light engine, portable....*176
Electric light for cars, Klabath's....*406
Electric light, Fuller's....*178
Electric light, hunting by....*361
Electric light in large cities, discussion on by W. H. Preece and others....181
Electric light in the German navy....*259
Electric light in the navy....*329
Electric light, influence of on plants....378
Electric light, influence of upon vegetation, and on certain physical principles involved. A paper by C. William Siemens, D.C.L., F.R.S. 229
Electric light, Jablochkoff's....*131, 167
Electric light, Jablochkoff's system of at Paris Exhibition....*307
Electric light, Kings'....227
Electric light, locomotive, Marshall's....*179
Electric light, Lontin's system....*213
Electric light, magneto, by Capt. Abney....131
Electric light measurement, apparatus for, by Robert Sabine, C.E....*387
Electric light, Rapieff's....134
Electric light, Schmidt's....*407
Electric light, some improved methods of producing and regulating, by H. Wilde....170
Electric light station of U. S. Illuminating Co., New York....*423
Electric light stocks, speculations in....378
Electric light, temperature of....279
Electric light tower, San Jose....*330
Electric light, the Jablochkoff system of....*141
Electric lights, actual costs of using, by J. H. Shoolbred....158
Electric lights, gas for producing....183
Electric lights, Reynier's, improvements in..*83
Electric lights, new, Lodighin's and Jablochkoff's....*100
Electric lights, small, from batteries, cost of running....195
Electric lighter, Desruelles'....*312
Electric lighters and extinguishers, Loiseau's, Ranque's, and Barbier's....*367
Electric lighters for domestic purposes, Loiseau's and Ranque's....*362
Electric lighters, Maigret's and Ranque's..*289
Electric lighting applied to navigation, by C. C. Soulages....*339
Electric lighting by batteries at the Comptoir d'Escompte, Paris....*354
Electric lighting, by Edward Briggs, C.E....154
Electric lighting, Brush system of construction and peculiar features of the dynamo-electric machine and of the lamps, by C. F. Brush.*274
Electric lighting by reflection, Partz's syst.*351
Electric lighting, dangers of....364
Electric lighting, incandescent, by J. Swan. 307
Electric lighting, its costs and appliances. A comprehensive survey of the subject, by Charles Wm. Siemens, LL.D....364
Electric lighting, lecture by J. W. Swan. 264, 265
Electric lighting, new system of and a new form of electric lamp, by Prof. E. Thomson and Edwin J. Houston....*155
Electric lighting of caves....*416
Electric lighting of the Brussels telegraph office. *371
Electric lighting. Report of the Franklin Institute Committee....314
Electric lighting, Swan system....*314
Electric lighting, the machines used for....99
Electric lighting, Thomson-Houston system. *388
Electric lighting, Zipernowsky system....*395
Electric locomotive engine, how to make, by G. F. Chutter....*19
Electric locomotive-lamp, Sedlaczek's....*334
Electric machine, alternating current, Ferranti's....*368
Electric machine and light, steam, for military purposes....*255
Electric machine, Carre's....*205
Electric machine, magneto, De Meritens....*209
Electric machine, di-, Abbe Le Dantec's.*245
Electric machine, dynamo and magneto, magnetic circuits in, note on by Lord Elphinstone and Charles W. Vincent....230
Electric machine, dynamo, Ball's....*403
Electric machine, dynamo, Brush....*274
Electric machine, dynamo, continuous-current, Hefner Alteneck's....*296
Electric machine, dynamo, Elphinstone-Vincent....*369
Electric machine, dynamo, for producing alternating currents, Gramme's....*155
Electric machine, dynamo, Gramme's combined. *233
Electric machine, dynamo, Gulcher's....*318
Electric machine, dynamo, Hopkinson and Muirhead's....*392
Electric machine, dynamo, Lontin's....*114
Electric machine, dynamo, how to make, with full directions and working drawings, by G. M. Hopkins. A valuable paper....*161
Electric machine, dynamo, Perry's....*283
Electric machine, dynamo, Weston's....*393
Electric machine, dynamo, with friction driving gear, Siemens'....*419
Electric machine, external armature, Siemens'. *387
Electric machine, magneto and dynamo, Fitzgerald's....*263
Electric machine, induction, Wimshurst's..*359
Electric machine, magneto, Breguet's....*43
Electric machine, magneto, Gramme's....*17
Electric machine, magneto, De Meritens'..*199
Electric machine, Niaudet's....*9
Electric machines, dynamo; a study of some of the circumstances which influence the efficiency of these apparatus, by Profs. E. J. Houston and Elihu Thomson....170
Electric machines, dynamo, an account of the important researches of Breguet on the theory of the Gramme and other forms of dynamo and magneto electric generators..222, *224, *225
Electric machines, dynamo and magneto, at the Paris Exhibition, by Dr. G. Glaser....307
Electric machines, dynamo and magneto, magnetic circuits in, by Lord Elphinstone and C. W. Vincent....*211
Electric machines, dynamo, by Dr. F. J. Lontin. *77
Electric machines, dynamo, De Meritens', by A. Guerot....*36
Electric machines, dynamo, hand, by W. H. Preece, F.R.S....354
Electric machines, dynamo, Jablochkoff's.*138
Electric machines, magneto and dynamo. A valuable paper by Aug. Gueront, giving a chronological history and brief description of the various kinds of magneto and electro dynamic machines known....*357
Electric machines, magneto and dynamo, by J. Angelo Fahie. Interesting particulars concerning the action of the best machines....369
Electric measures, unities of, decision of Congress of Electricians on....312
Electric meter, Hopkinson's....*381
Electric motor, Burgin's....*323
Electric motor, Deprez's....*212
Electric motor, new, by Wm. W. Griscom....267
Electric motor pendulum, Higgs'....*58
Electric motor, Trouve's, its applications.*259
Electric musical instruments shown at the Centennial....46
Electric night-signal, railway, Coupan's...*301
Electric objective for instantaneous photography....*411
Electric paper, how to make....274
Electric pen, improved....*414
Electric pen, or horograph....*183
Electric pen, simple....*166
Electric phenomena, simulation of by liquid or gaseous currents, by C. Decharme....*390
Electric photometer, Vidal's....*270
Electric pile, dry, Van Tenac's....58
Electric pile, thermo, Clamond's....*211
Electric power....303
Electric power hammer, Deprez's....*352
Electric probe and extractor, Trouve's....*29
Electric railway, run by accumulators....*342
Electric railway apparatus at the Paris Electrical Exhibition....*315
Electric railway at Brighton....409
Electric railway, Ayrton and Perry's....*335
Electric railway, Binko....352
Electric railway brake, Boothby's....*221
Electric railway, coal mine....*378
Electric railway, Edison's....336
Electric railway, Kew, England....*382
Electric railway, Portrush, Ireland....388
Electric railway, Siemens'....*242
Electric railway, Siemens', improvem't's in.*235
Electric railway, Siemens', at Zankeroda Mines. *417
Electric railways and transmission of power by electricity, by Alexander Siemens....306
Electric railways, Perry and Ayrton's....*332
Electric range-finder....56
Electric signal for divers....*93
Electric signals for railways, Siemens and Halske's....*65
Electric signal for trains, Dacousso's....*380
Electric siphon, hydro, Maxim's....*424
Electric speech-recorder, Gentilli's....*293
Electric stop-motion, by W. H. Bailey....*151
Electric stop-motion for drawing-frames..*362
Electric stop-motion in the cotton mill....299
Electric street passenger car....*383
Electric submarine monitor, Tuck's....400
Electric telemeter, Siemens'....*363
Electric totalizing integrator, Abakanowicz's. *369
Electric tramcar of the French Electrical Storage Co....*408
Electric tramway at Paris, Siemens'....*306
Electric tramways, new system of, by M. H. Smith....*411
Electric transmission and storage. Lecture by Dr. Wm. Siemens, F.R.S....384
Electric trial-bell, Desruelles'....*381
Electric tricycle, Ayrton and Perry's....*367
Electric tricycle, Ayrton and Perry's....*420
Electric tuning-forks and their uses....*365
Electric voting apparatus....*195
Electric wires, thickness of necessary to carry different currents without heating, by Prof. G. Forbes....354
Electric works of Paris, lighting of the stores of the Louvre and the Hippodrome....*237
Electrical accumulators, by Prof. Oliver J. Lodge, D.Sc....342
Electrical alarm compass, Severn's....*195
Electrical and telephone experiments. Abstract of a lecture by Alexander Graham Bell....117
Electrical apparatus at the Paris Exhibition *153
Electrical appliances, future development of, by Prof. John Perry. An interesting survey of the present condition and future prospects of the industrial use of electricity....*283
Electrical attraction, experiment on....*247
Electrical batteries, many forms (see Batteries).
Electrical brake, Spottiswoode's....*51
Electrical cabinet, by Geo. M. Hopkins. Description of a simple and inexpensive electrical cabinet, which may be combined to form several pieces of apparatus, and which any amateur may easily construct for himself and perform a great variety of experiments with....*191
Electrical clocks and clock work....*198
Electrical conductivity, by H. Tomlinson..334
Electrical conductors, by W. H. Preece....420
Electrical conductors, devices for overcoming induction in, by C. J. Kintner....323
Electrical course indicator for ships....*332
Electrical currents, improvements in generating, by A. G. Bell....*72
Electrical currents, measurement of, by W. H. Preece....112
Electrical currents, mechanical production of; a simple and intelligible explanation of the principles that are involved in the production of electric currents mechanically....*324
Electrical currents, animal, Radcliffe's researches on....30
Electrical Exhib., Internat., Paris, 1881....271
Electrical exposing shutter, new, by D. Edwards....*347
Electrical fire damp photometer, Liveing's. *253
Electrical horticulture; some applications of electric energy to horticultural and agricultural purposes, by Dr. C. W. Siemens....304
Electrical illumination, report upon by Prof. Tyndall to the Trinity Board....103
Electrical incandescent lamps acting in the open air, Reynier's....*356
Electrical induction machines, opinions of various scientists upon....237
Electrical induction, sonometry by....*184
Electrical lighting, Edison's system of as shown at the Paris Exhibition of Electricity....*309
Electrical log, Kelway and Dyer's....*326
Electrical machine, Holtz, by G. M. Hopkins. Details of construction of several simplified forms of the Holtz electrical machine, with working drawings, to enable any one at slight expense to make a single or double plate apparatus. Accompanied with descriptions of a large number of interesting and instructive experiments in static electricity which may be performed with this machine..*278, *279, *282
Electrical machine, Holtz, new....*70
Electrical machine, Voss-Holtz....*291
Electrical machines, an important problem and its solution, by Theodore Wiesendanger...*253
Electrical machines, induction, observations of Mr Holtz on....*321
Electrical measurements, apparatus for....*329
Electrical method for determination of manganese, nickel, zinc, and lead, by A. Riche....92
Electrical middlings purifier, Osborne's...*235
Electrical movements of camphor on water, by P. Casamajor....103
Electrical novelties at the Paris Electrical Exhibition, by C. S. H. Small. Notes on various interesting exhibits; Edison exhibit; Tissandier's motor for balloons; Kastner's pyrophone; Maxim's electric light; Collins' electric clocks; electric lighthouse; Bolvin's exhibit; Cumming's periphery contact key....311
Electrical ozonizer, Leeds'....*203
Electrical phenomena, the alleged etheric force, test experiments as to the identity of with induced electricity, by Profs. E. J. Houston and Elihu Thomson....*21
Electrical postal tramway, Siemens'....*326
Electrical railway, Gross-Lichterfelde, near Berlin, Siemens-Halske....*292
Electrical researches, Warren de la Rue and Hugo Muller's investigations of the interesting phenomena that accompany the electric discharge....275
Electrical resistances, instrument for testing, Bucknill's....*296
Electrical researches, interesting; an account, by Dr. Siemens, of recent applications of the dynamo electric current to metallurgy, horticulture, and the transmission of power....239
Electrical researches, interesting; an account, by Dr. Siemens, of recent applications of the dynamo electric current to metallurgy, horticulture, and the transmission of power....*356
Electrical ship's log, Kelway's....*366
Electrical shunts, abstract of a paper by W. H. Preece....*67
Electrical smoke figures; method of producing very curious phenomena with smoke....93
Electrical static repulsion....56
Electrical storage, a system of, by Profs. E. J. Houston and Elihu Thomson....*215
Electrical telemeter, new....*229
Electrical time gun at Pernambuco....*21
Electrical totalizing counter, Froment's..*278
Electrical traction; account of experiments recently made in Paris on tramcar propulsion by means of electricity....402
Electrical transmissions, role of the earth in, by Th. Du Moncel....223
Electrical vortices, by J. J. Lake....*38
Electricity and gas as heating agents....276
Electricity and gas, facts about....259
Electricity and gas, the competition between in Paris....221
Electricity and gas, the light and energy of, by J. T. Sprague....192
Electricity and light, relation between, by Dr. O. J. Lodge....275
Electricity, apparatus for measuring, by E. Mercadier....*365
Electricity, application of to railway trains. *345
Electricity, application of to the illumination of the inner cavities of animals....*285
Electricity as a cosmical agent, by G. D. Hiscox. 424
Electricity as a motive power, by Prof. W. E. Ayrton....198
Electricity, atmospheric, by David Brooks..252
Electricity, atmospheric, origin of, and its connection with the electrical occurrences upon our globe, by L. Zehnder....397
Electricity, bleaching by....*410
Electricity, breaking horses by....*208
Electricity, can power in large amount be transmitted by it, by N. S. Keith....87
Electricity, disruptive discharge of, by Alex. Macfarlane, D.Sc., and P. M. Playfair, A.M. 231
Electricity, domestic; Maigret's and Ranque's lighters....*289
Electricity, dynamic, development of by means of static....2
Electricity, economy of, by J. Faulkner....28
Electricity, effect of on particles suspended in liquids, by Mr. Holtz....32
Electricity, effects of reproduced by vibrations; results obtained by Mr. Bjerknes....*315
Electricity, Exhibition, of International, Paris, 1881....*300, 301
Electricity, growing plants by....*242
Electricity, fusion of metals by....*242
Electricity, heat, and light, are they expressions of the same force, by Prof. Elihu Gray....379
Electricity, illumination by, by J. Jamin....132
Electricity in coal mines....402
Electricity in dyeing and printing, by F. Goppelsroeder....352
Electricity in the carding room....282
Electricity in war, by H. B. Pritchard....92
Electricity, influence of vacuum on....*382
Electricity, lighting by, by R. Briggs....98
Electricity, medical, by Dr. E. G. Loring....55
Electricity, medical, by Dr. W. H. Stone....332
Electricity on tramways....304
Electricity, phenomena of, imitation of by liquid or gaseous currents, by C. Decharme....*418
Electricity, photo, by Professor G. M. Minchin. *253
Electricity, positive and negative, difference in actions of, by E. Mach and S. Doubravn....235
Electricity, practical uses of, by Prof. Charles A. Young. An untechnical manner the extent and variety of the existing applications of electricity to the arts of life, and reasons for expecting their rapid multiplication in the near future....285
Electricity, printing music by....*365

Electricity, recent wonders of, by W. H. Preece. A valuable and interesting paper.....327, 328
Electricity, removal of hair by, by G. H. Fox, M.D.....176
Electricity, report of sounds by.....157
Electricity, static, curative applications..*282
Electricity, static, transformation of into voltaic currents.....368, 369
Electricity, storage of; the opinions, *pro* and *con.*, of various English scientists as to the value of the Faure battery.....289
Electricity, storage of, by Plante's secondary pile, and Houston & Thomson's batteries..*234
Electricity, the modern development of Faraday's conception of, by Prof. Helmholtz...*284
Electricity, the age of, by Prof. S. P. Thompson.....359
Electricity, the applications of, by Sir Frederick Bramwell, V.P.Inst.C.E.....382
Electricity, the earth as a conductor of, by John Trowbridge.....245
Electricity, the essential nature of, by J. T. Sprague.....*221
Electricity, thermo, the nature of, Kohlrausch's hypothesis in regard to.....27
Electricity, what it is and what may be expected of it, by Jacob Reese.....312
Electrified oxygen and linseed oil.....241
Electro brassing and bronzing, direct'ns for.164
Electro capillary phenomena of the human body, by E. Onimas and C. Legras.....141
Electro capillary phenomena, by P. Higgs..*58
Electro deposition, influ. of magnetism on.*411
Electro dynamic balance, Debrun's.....*355
Electro dynamo transmission.....218
Electro gilding directions for.....160
Electro gilding, Ebermayer's process of.....112
Electrolysis, a new experiment in, by Eugene Semmola.....*381
Electrolysis, figures obtained by.....*426
Electrolytic balance of chemical corrosion, by George Gore, LL.D.....381
Electrolytic determinations and separations, by Alex. Classen and M. A. Von Reis.....299, 326
Electrolyzing apparatus for impure alcohol, improved, Naudin's.....*415
Electro-magnet, new form of, by Prof. Fred. Arzberger.....*331
Electro-magnet, the, a receiving telephone. A paper by F. G. Lloyd, showing that a good receiving telephone can be made from electro-magnets without any vibrating diaphragm...147
Electro-magnetic apparatus, Pacinotti. *315
Electro-magnetic bells, full directions how to make, with working drawings.....*162
Electro-magnetic engine, Deprez's, by Th. Du Moncel.....190
Electro-magnetic engine, new, Egger's...*78
Electro-magnetic engine, Sawyer's.....*19
Electro-magnetic induct'n, molecular..*281
Electro-magnetic locomotive, Davidson's. *359
Electro-magnetic machine, Varley's. *119, *125
Electro-magnetic railway brake, impr..*111
Electro-magnetic railway brake, Wilke.*411
Electro-magnetism as a prime mover.....359
Electro-magnets and induction coils, improvements in, by Prof. John Trowbridge.....23
Electro-magnets, descriptions and illustrations of the principal forms of the apparatus that have hitherto been devised.....*182
Electro-mania, by W. Mattieu Williams...344
Electro-metallurgy. A valuable technical paper, giving detailed directions for doing all kinds of electroplating, also describing the processes of electrotyping and stereotyping...*310
Electro-metallurgy, photo, by W. Watts. 220
Electrometer, capillary, Claverie's.....*413
Electrometer, capillary, Debrun's.....*240
Electrometer, quadrant, Edelmann's.....*421
Electrometer, quadrant, Thomson's.....*377
Electrometer, quadrant, Thomson's.....*423
Electrometer, reflection, Mascart's.....*258
Electrometer, registering, Mascart's.....*398
Electrometer, Rhe-, Meisens'.....*29
Electrometer, Zinger's.....*421
Electrometers, capillary, descriptions and figures of several kinds.....*83
Electromotive force.....370
Electromotive force, resistance, and current, by J. T. Sprague. A valuable paper, showing what physical realities underlie the terms and formulæ used by electricians.....178
Electromotive changes produced by light, by Prof. Dewar.....28
Electro-motor, Chutaux's.....38
Electro-motor, Elias'.....*315
Electrophone, Maiche's.....*257
Electrophorus, a simple.....*271
Electroplating baths, compound, Thenard's investigations on.....77
Electroplating, cobalt, process of, by I. Adams. 13
Electrostatic machine and recharger, Humbiot's.....*329
Electrotype method for photo-reliefs.....418
Electrotype plates from drawings, how to make, by Joseph Brown.....141
Electrotypes, how to take.....310
Electrotypes of iron, solution for.....92
Electrotyping non-conducting materials, new process for.....224
Elements, nature of, by J. N. Lockyer.....169
Elephant, a notable; removal of Jumbo from London to New York.....*328
Elephant, autopsy of, by A. J. Howe, M.D.186
Elephant battery.....*234
Elephant, birth of, by G. E. Sussdorff, M.D. *343
Elephant, head of, structure.....*337
Elephant, white, Barnum's.....*427
Elephant's milk, composition of, by Dr. C. A Doremus.....288
Elephants, utilization of in Brit. Burmah.*404
Elevating apparatus at Briancon.....*410
Elevator B, central, for grain, St. Louis...*79
Elevator, cyclic, Hart's.....*353
Elevator, grain, American, in London.....*220
Elevator, grain, Behrns and Anruth's.....*299
Elevator, grain, pneumatic, improved.....*133
Elevator, grain, Poulson's.....*411
Elevator, grain, Rennie's.....*231
Elevator, grain, the American system of...381
Elevator, grain, the Watson plan of.....*389
Elevator, hydraulic, for canals.....*334
Elevator, hydraulic, Tangye's.....*286
Elevator, passenger and vehicle, of the new steam ferry, London.....*47
Elevator, passenger, for dwellings, Potter's. *10
Elevator, pneumatic, mountain railway..*276
Elevator truck, Poirot's.....*331
Elevator, twin stairs and light-shaft, by Samuel Gray.....*28
Elevators and motors, hydraulic, by B. F. Jones. 392
Elliquation of alloys, an interesting account of some phenomena connected with different alloys of lead and antimony used in the manufacture of printing types.....227
Ellipse, a newly discovered property of, and its application to the oval chuck, by F. M. Leavitt. *272
Ellipses, compasses for drawing.....*405
Ellipses, simple apparatus for describing, by Prof. E. J. Hallock.....*415
Embalming the dead, modern method of, by B. W. Richardson, M.D.....*155
Embalming, Tranchina's method of.....51
Embossing machines for wearing apparel, Steinlein's.....*15
Embrasures and guns, mechanism for, Gruson's.....*408
Emery and corundum wheels for grinding and surfacing metals and other materials, by A. H. Bateman, F.C.S.....125
Emery grinder, Bollman's.....*331
Emery grinder, improved.....*117
Emery grinders for sharpening tools.....*269
Emerald, green color, cause of.....351
Emeralds, discovery of in North Carolina, by Wm. E. Hidden.....336
Emma Mine.....109
Emotional prodigality. A paper by C. Fayette Taylor, M.D., showing the exhausting effect that emotional excitement produces upon the bodily functions.....196
Emulsion, how to make in hot weather, by A. L. Henderson.....299
Emulsion, Lohse's method of preparing....289
Emulsion, manipulations, by H. J. Newton, 89
Emulsion photo-plates, by H. J. Newton.... 48
Emulsion process, collodio-bromide, applied to transparencies; and enlarging without a nitrate bath.....64
Emulsion processes, modification of.....273
Emulsions, by Prof. C. Lewis Diehl.....343
Emulsions, improvements in methods of treating, Piener's.....343
Emulsions, mixing.....*96
Emulsions, rapid, by H. G. Inskipp.....116
Emulsions, washed and unwashed.....10
Enamel for hollow iron ware.....248
Enameling pottery, practical directions for, with recipes for different colors, by Millway Vanes.....387
Enamels for metals.....7
Encaustic tiles, how made.....402
Energy, electrical storage of, by O. Lodge...416
Energy minimum, experimental illustration of, by Sir Wm. Thomson.....*263
Energy, potential, by S. T. Preston.....87
Energy, the transmission of. An interesting and valuable paper by Prof. Reynolds, treating of the different sources of energy and of their storage and transmission.....413
Energy, various forms of, an attempt at a systematic classification of, by O. J. Lodge.....208
Engine, ammonia, Gamgee's.....*281
Engine, blowing, Morris'.....*39
Engine, caloric, Ericsson's.....*70
Engine, caloric, solar, Ericsson's.....*218
Engine, compound, 16-horse, Garrett's...*297
Engine crank, broken, how repaired with wire rope.....*287
Engine, electro-magnetic, Deprez's.....190
Engine, electro-magnetic, Egger's.....*78
Engine, fire (see Fire-engine).
Engine, gas, Ewins and Newman's.....*360
Engine, hoisting, Williamson's.....*35
Engine, hot-air, Rider's.....*49
Engine, hot-air (see Caloric and Hot-air engines).
Engine, hot-air, Todt's.....*284
Engine, hot-air, the Sachsenberg.....*162
Engine, hydrocarbon, Brayton's.....*58
Engine, marine, progress and development of, by F. C. Marshall, M.E. A very valuable paper, giving the history and progress of marine engineering, describing the most approved types of engines and boilers now employed, materials and mode of manufacture, performances and economies, consumption of fuel, results of screw propeller, suggestions for improvement.....299
Engine, pumping, Corliss, for Pawtucket.*183
Engine, railway (see Locomotive).
Engine, steam, six cylindered, West's.....*59
Engine, sun, Mouchot's.....*167
Engine, thermodynamic, Gamgee's.....*281
Engine, traction, agriculture, Fowler.....*88
Engine, traction, steam, Robey's.....*6
Engine, water, Wigzell and Pollit's.....*270
Engine, winding, portable.....*64
Engineering, American, as illustrated by the American Society of Civil Engineers at the Paris Exhibition of 1878. Compiled by George S. Morison, Edward C. North, and John Bogart, committee.
I. Foundations.....187
II., III. Bridge superstructure.....188, 189
IV. Hydraulics.....193
V. Internal navigation.....*199
VI. Railroad rolling stock.....203
VII. Rivers and harbors.....206
VIII. Gas engineering.....*206
Engineering and artillery experiments in England.....*59
Engineering and science, by W. R. Browne. 417
Engineering, civil, training for students in, by Geo. L. Vose. An interesting and valuable paper.....368
Engineering experiences in Northwestern Wisconsin in making a railroad survey, by F. W. D. Holbrook.....399
Engineering in America, abstract of a paper by Mr. O. Chanute.....239
Engineering in Peru.....136
Engineering, marine, and shipbuilding on the Clyde.....60
Engineering, mechanical, developments of in every direction in the last half century; an address by Sir Frederick Bramwell, F.R.S., before the British Association.....312
Engineering, mechanical, our progress in; address by Prof. R. H. Thurston, before the American Society of Mechanical Engineers.....308
Engineering, mechanical, progress of, address by Prof. R. H. Thurston. A valuable and interesting paper.....364
Engineering, popular fallacies in, and how to meet them; an address before the graduating class of Stevens Instit. by Henry Morton....236
Engineering, telegraphic, American, progress of.....241
Engineering works, recent important, in bridges, viaducts, tunnels, canals, dockyards railways, lighthouses, etc., by J. Brunlees...373
Engineers, English, and American bridges..153
Engines, blowing (see Blowing).
Engines, carding, Klein's.....*78
Engines, compound, of steamer Britannic..*51
Engines, compressed air, by J. Young.....*309
Engines (for engravings and descriptions of the engines of many large and splendid steamers, see heading of Steam engines).
Engines for rolling mills, Davey's.....*391
Engines, gas, Gilles'.....*44
Engines, gas, improved, Cropper's.....*95
Engines, gas (see Gas engines).
Engines, high-pressure, causes of knocking in, by Joshua Rose. A valuable paper.....*1, *2
Engines, marine, governors for.....*269
Engines of steamer La Normandie.....*402
Engines of the Gallia.....*202
Engines, passenger, fast.....301
Engines, pumping, of the Lawrence, Mass., waterworks.....*66
Engines, pumping, of Lehigh Zinc Works..*32
Engines, pumping (see Pumping engines).
Engines, steam, revolving cylinder, description of various systems of.....*211
Engines, steam (see Steam engines).
Englethwaite, near Carlisle.....*330
English industries and American competition. 139, 142
Engraving, chemigraphic.....370
Engraving machine, electric.....*153
Engraving machine, pantograph, Hope Co..29
Engraving, photo-electro.....143
Engraving, photo-mezzotint.....74
Engraving, photographic.....158
Engraving photographic, in half-tones...*41
Engravings, old, how to clean.....115, 124
Engravings, steel, soiled, how to restore... 44
Enlargement, finished, cheap and effective, by G. Croughton.....276
Enlarging on canvas, practical method of, by G. H. Martyn.....353
Enlarging on argentic paper and opals, by A. Goodal.....415
Ensilage, a chemical view of, by H. P. Armsby.....262
Ensilage by W. I. Chamberlain.....291
Ensilage, by O. B. Potter.....241
Ensilage fodder.....246
Ensilage in nature; the stomach of a ruminant a silo in miniature.....320
Ensonflage appar., for making perfumes.*288
Entozoa, abnormal, in man, by Rev. Samuel Lockwood.....274
Entozoa, or internal worms.....*188
Eosine, applications of in dyeing.....59
Eosine, its properties and applications.....14
Epicycloidal and involute teeth for inside gear, forms of, by Prof. C. W. MacCord...*291
Equatorial stand, simple, for telescope, how to make.....*78
Equatorial, simple, how to make, by E. Lasant. *291
Equilibrium, experiment on.....*410
Ergot and soda phosphate, exhilarating effects of.....316
Ergot, by W. Carruthers, F.R.S.....*127
Erica cavendishiana.—Philesia buxifolia...*362
Esparto grass of Tunis.....180
Etching on glass, bath for.....169
Ether spray for neuralgia, by Dr. McColgnan. 352
Etheric force, test experiments as to the identity of with induced electricity, by Profs. Houston and Thomson.....*21
Etherspheres as a *vera causa* of natural philosophy, by Rev. S. Earnshaw.....197
Ethyl bromide, a new anæsthetic.....218
Etna, eruption of, March 20, 1883.....*388
Eucalyptus globulus, by Consul J. Wilson..298
Eucalyptus, oil and soap from.....185
Eucalyptus trees, characteristics, cultivation, and economic value of, by E. L. Baker.....378
Euthanasia, natural, by Dr. B. W. Richardson. 15
Evaporating apparat. Perre and Quidet's..388
Evaporation, economical apparatus for, Piccard's.....*147, *250
Everlasting flowers.....*366
Every man his own sensitive plate maker..*272
Evolution and human anatomy; a paper by Stanford E. Chaille, A.M., M.D., pointing out the numerous indelible marks of man's lowly origin that are to be found in some of the neglected departments of anatomy.....168
Evolution, doctrine of, abstract of a paper by Prof. E. S. Morse.....40
Evolution, theory of, abstract of three lectures by Prof. Huxley.....41, 42, 44
Excavation, subaqueous; driving piles or making solid foundations in quicksands or unstable soils, by Chas. Pontez.....*237
Excavating apparat. Bruce and Batho's..*332
Excavating apparatus, odoriess.....*62
Excavating machine, steam, Dunbar and Ruston's.....*87
Excavating machine, steam, Ruston, Proctor & Co.'s.....*68
Excavator for sinking cylinder foundations, Diack's.....*103
Excavator, Reeves'.....*102
Excavator, steam, new, Chaplin & Co.'s...*64
Excavator, submarine, Bazin's.....*354
Excavators at Calais Harbor, Couvreux's.*238
Exercises, systematic, value of in the prevention of disease, by Edward T. Tibbits, M.D. A highly important and valuable paper..150, 152
Exhaust chamber, new, for locomotives..*141
Exhauster and blower, Brakell's.....*53
Exhibition, Brussels, permanent, purposes of. *226
Exhibition, Centennial, British official reports on.....90
Exhibition, Centennial, list of Judges, American and foreign.....30
Exhibition, Fisheries, London.....*412
Exhibition Internat., Buenos Ayres ...*305
Exhibition, International, at Nice.....*395
Exhibition, International, Melbourne....*221
Exhibition, International, N. S. Wales...*170
Exhibition, Melbourne, 1880-81, awards to American exhibitors.....287
Exhibition, Mining and Indust., Denver.*330
Exhibition, Naval and Submarine, London, two full-page illustrations of various interesting apparatus.....*335
Exhibition of Electricity, Vienna.....*408
Exhibition of Electricity, International, Paris, 1881.....*300, 301
Exhibition, Paris, an impressionist at the. An interesting series of notes and observations on some of the more interesting exhibits.149, 150
Exhibition, Paris, award of prizes in the American Department.....149, 150
Exhibition, Paris, list of jurors who represented the United States.....138
Exhibition, Sanitary, Internat'l, London.*298
Exhibition, Swiss, at Zurich.....*395, 409
Exodus, buried city of the. An account of the recent excavations and discoveries of Pithom Succoth in Egypt.....*401
Expedition, Challenger, general results of.. 32
Explosion as an unknown fire hazard.....288
Explosive bodies and mixtures, by Charles Rice. A comprehensive and valuable paper.....146
Exploding machine, electric, for mining..*319
Explosions from combustible dust.....*166
Explosions by freezing.....*251
Explosive combinations in pharmacy.....300
Explosive compounds, by Sir Frederick Abel. An interesting account of the changes that have been introduced into the manufacture of gunpowder and other explosives in recent times. 406, 407
Explosive mixtures of coal-gas and air, by W. Foster.....243, 245
Explosives containing nitroglycerine, analysis of, by F. Hess.....342
Explosives for blasting, modern.....127
Explosives, measuring the force of by photography.....88
Exposure and development, simultaneous,. 97
Extraction apparatus, automatic, Julhe's, for fluid extracts.....*225
Extraction appar. continuous, Weigelt...*292
Extractor for dyewoods, etc., Schorm's...*373
Extracts, preparation of, without heat, by Prof. A. Herrera.....92
Eye as an aid in photometry.....*408, *409
Eye, cataract of, mode of operating for, by A. Chevalier.....*139
Eye, defects of, and the use of spectacles for, by Dr. D. S. Reynolds.....143
Eye, how to remove foreign bodies from, by Prof. Dugas.....84
Eye, how to extract particles of metal from. *147
Eye, human, from a photographer's point of view, by D. G. Thompson, M.D.....*335
Eye, paralysis of the muscles of, treatment of, by Prof. J. Michel.....122
Eye, removing steel from with magnets.....232
Eye-glasses, interesting facts concerning...386
Eye-pieces for microscopes, improved, by J. H. Wythe, M.D.....*230
Eye-pieces for telescopes and microscopes, a paper by G. D. Hiscox, illustrating various approved forms of eye-pieces, and giving formulas for constructing and tables of powers.....*399
Eye-pieces for telescopes, impr., Nystrom's. *7
Eye-pieces, powers of, how to make an instrument to gauge.....*225
Eye, powers of, and instrumentation, by Dr. Royston-Pigott.....49
Eyesight, art of preserving, by Arthur Chevalier. A plain, comprehensive treatise, explaining the anatomy of the eye; the phenomena of vision, and the reflection, refraction, and dispersion of light; the ophthalmoscope and its use; diseases of the eye, and treatment; colored glasses and their use; hygiene of the eye; care for the eyes of children and infants; instructions to the aged; extraction of foreign bodies from the eye; eyewashes and their composition, and directions for their application....*125, *127, *130, *136, *139, *142, *144, *147
Eyes, emmetropic and ametropic, some points in the management of asthenopic symptoms in; two valuable lectures by O. D. Pomeroy, M.D...255
Eyes, hygiene of, advice on.....147
Eyes of science—telescopic, microscopic, spectroscopic, and photographic, by R. A. Proctor...305
Eyes, right and left, relative amount of work done by.....293
Eyes, the care of, being questions submitted to Dr. R. G. Loring, Jr., by the New York Medico-Legal Society.....73

F

Fabrics, apparatus for hot pressing.....*224
Fabrics, color designs for.....*331
Fabrics, detection of silk, wool, linen, and cotton a, with a method for their quantitative estimation; also the determination of the sizing and coloring matter.....326
Fabrics, dyed, metallic gloss for, recipe.... 33
Fabrics, finishing, machines for, French..*253
Fabrics, machine for beating.....*314
Fabrics, Oriental style as applied to. A valuable paper for designers.....*151, *155
Fabrics, Oriental style as applied to, illustrated with numerous designs.....*164
Fabrics, recipes for making fireproof.....245
Fabrics, strength of, dynamometer for measuring.....*78
Fabrics, test for the dye of.....187
Fabrics, textile, how to ornament with figures of natural leaves.....181
Fabrics, textile, tanning liquor for, recipe... 39
Fabrics, woven, manufacture of by the systems of Scott and Edelston.....*238
Facade of Belgian section at Paris Exhib..*150
Facade of Spanish Section at Paris Ex....*153
Face in shadow, by W. Heighway.....139
Face painting; the actor's art.....425
Falling motion, origin of.....240
Falls of St. Anthony.....256
Fan-brake for railways, improved.....*396
Fan, new, Capel's.....*380
Fanning mill elevator, and weighing machine, English.....*156
Fans, efficiency of.....*360
Fare-register, novel, Johnson's.....*1
Farm buildings, English.....*118
Farm, model, in Normandy.....150
Farms, small, well-tilled, possibilities of.... 90
Farming, English vs. American.....139
Farming, how to make it pay.....4
Farming in Southwestern Minnesota, the soil, tools used, instructions, costs of working the land, wages, climate, etc.....225
Farming. Southern.....238
Farm Law. A valuable paper by Hon. Edmund H. Bennett. How to buy a farm. How far the farm extends. What a deed of a farm includes. Rights in the road. As to farm fences. Impounding cattle. Farmer's liability for his animals. Dogs. Water rights and drainage. Trespassing on the farm. Hiring help. Liability for employes. About fires. Ways over the farm. Warrant of seeds.....166, 174
Fast, Dr. Tanner's, history of.....*244
Fast, forty days, of Dr. Tanner.....*242
Fat in animals.....95
Fats, glycerine, oils, etc.; their separation. A paper containing a large amount of information concerning the industries relating to these products.....278
Fauna, Eocene, of Southern Patagonia....425
Favre, Louis, constructor of St. Gothard Tunnel. An account of his labors, with portrait...*365
Fear, morbid, as a symptom of nervous disease, by G. M. Beard, M.D.....194
Feather dyeing, hints on, by Paul Alex....255
Feathers, how to bronze.....163
Feathers, ostrich, how to bleach.....192
Feathers, recipes for dyeing.....269
Feed apparatus, automatic, for steam boilers, Fromentin's.....*244
Feed apparatus for boilers, Lethuillier's.*375
Feeding by the nose, apparatus for, Newington's.....*166
Feed-water, a new magnesia process for...154
Feed-water apparatus, auto., Cohnfeld's..*192
Feed-water heater, simple.....*39
Feed-water heater and purifier, Strong's.*363
Feed-water heater, Atkinson's.....*141
Feed-water heater, Carvalho's.....*112
Feed-water heater, Martin's.....*158
Feed-water heater, Northcott's.....*19
Feed-water heaters at the Centennial.....*16
Feed-water, heating of, by J. Haug.....76, 90
Feed-water injectors, descriptions and illustrations of the various systems in use.....*356
Feed-water, purification of.....393
Feed-water pump and regulator, Gauchot's. *407
Feet, bad odor from, remedy for.....257
Feet, graphical method as applied to the study of. 351
Feldspar, common, or orthoclase.....72
Feldspar, the species and characteristics of..347
Felons, remedy for, by T. C. Brannon, M.D.243
Felt, how to dye.....90
Felt, how to dye scarlet.....281
Fenestration, scientific. An investigation of the proper forms, dimensions, number, and positions of windows for buildings for various purposes.....263
Fences and house-trimmings, ornamental, suggestions for.....*68
Fences, slate, how to construct.....*410
Fermentation; abstract of a paper by Dr. A. P Aitken.....76
Fermentation, fire risks of.....376
Fern, basket, miniature, Odontoglossum..*395
Ferns, how to grow in glass cases.....45
Ferns of the Pacific coast, by Mrs. S. A. P. Lemmon.....283
Ferryboat, twin-screw, Mersey ferries....*348
Ferryboat, Loftus Perkins; description, with three full-page engravings, showing details of machinery.....*217
Ferryboat Solano, Central Pacific R.R.....*399
Ferryboats, steam, French.....*299
Ferry system, Robert Fulton's.....*199
Fertilizer, road washings as.....290
Fertilizers, application of to roots.....318
Fertilizers for corn.....166
Fertilizers, home-made, by H. Reynolds ...378
Fertilizers, how made at Atlanta.....316
Fertilizers, manufacture of from sewage..397
Fertilizers, tree leaves as.....80
Fertilizers, valuable formulas for making.132
Fever, constant bath treatment of.....252
Fever, hay, and asthma. A lecture by Prof. Alonzo Clark, M.D.....221
Fever, intermittent, pilocarpin in, by Dr. Gaspar Griswold.....201
Fever, marsh, sulphur as a prophylactic of..358
Fever, scarlet, a clinical lecture by Alonzo Clark, M.D.....239
Fever, scarlet, fresh air for.....314
Fever, scarlet, suggestions for preventing the spread of.....172
Fever, typhoid, by Austin Flint, M.D.....251
Fever, typhoid, curability of in the prodromal stage.....380
Fever, typhoid, cold water in, by Dr. J. W. Kibbee.....171
Fever, typhoid, diagnosis and hygiene of, by Dr. E. Hochheimer.....409
Fever, typhoid, Dr. Rothe's antiseptic method of treating.....251
Fever, typhoid, from well water, by Dr. J. A. Post.....63
Fever, typhoid, how to treat.....143
Fever, typhoid, is it contagious, by Dr. T. J. Maclagan.....207
Fever, typhoid, treatment of, by Dr. A. L. Loomis.....60
Fever, yellow, infectious nature of, by Dr. J. J. L. Donnet.....128
Fever, yellow, its origin, propagation, and treatment, by Dr. A. Stillé. A valuable paper...190
Fever, yellow, microscopical observations, by Dr. J. B. Marvin.....161
Fever, yellow, nature of poison, and prevention, by Dr. H. D. Schmidt.....181
Fiber plants of India, their cultivation, preparation, and uses, by J. W. Minchin.....407

Fiber, vulcanized 43
Fibers, animal, characteristics of 191
Fibers, cotton, effect of the drawing and carding processes on *300
Fibers, textile, under the microscope. Illustrations, by highly magnified figures, of the distinctive characteristics of the leading textile fibers—silk, wool, and cotton *292
Fibers, vegetable, action of reagents on 152
Fibers, vegetable, action of reagents on 159
Fibrous materials, apparatus for conditioning, Hirzel's *283
Field-glass, photographic *332
Fig culture at the north; a new industry 171
Fig culture in Turkey 269
Filaria disease 378
Filaria in the eye *168, 169
Filaria sanguinis hominis 320
Fi e-holding appliances, by Joshua Rose *11
File sharpener, sand blast, Tilghman's *416
Files, American *54
Files vs. emery wheels and milling tools, by Joshua Rose. Practical suggestions on proper use of the emery wheel, milling tools, buff wheel, files, etc., and grades and character of work to which each should be applied. Best methods for hard metal work, saw filing, roughing down, trimming of castings, cylindrical work, etc. 63
Films, liquid, Plateau's *160
Filter, automatic, Robinson's *426
Filter, carbon, siphon *262
Filter, centrifugal, Autier and Allaire's *29
Filter, cheap and efficient, for industrial works, how to make *404
Filter, gelatine *217
Filter, intermittent, Denton's *56
Filter, rapid, Maignen's *215
Filter, rotary, Perret's *67
Filter, self-regulating, for photographers *187
Filter, self-regulating, for silver baths *187
Filter, sponge, improved *343
Filter, sponge, Perret's *426
Filter, universal, Platt's *162
Filtering and percolating stand, new *109
Filtering and purifying water 195
Filtering apparatus, new *168
Filtering apparatus, Farquhar and Oldham, *276, *291
Filtering app. for viscid liquids, Elsden's *293
Filtering apparatus, rapid, simple *281
Filtering apparatus, Schuricht's *421
Filtering cistern, Moscucci's *145
Filtering press, high pressure, Bertin-Godot, *319
Filtering press, hydraulic, for treating oleaginous seeds, Laurent and Collot's *358
Filter-press for retaining the most finely divided precipitates, by J. E. Foakes *391
Filter-press, twisting, Gigot's *293
Filter-press, Von Gross-Klanin's *337
Filters, asbestos, by P. Casamajor 380
Filters, improved *225
Filters, improved, self-cleaning *110
Filters, silicated carbon and spongy iron 165
Filters, water, the utility of 209
Filth diseases in rural districts, by Dr. A. L. Carroll 404
Filtration, rapid, of the carbon in cast iron and steel analyses, device for *216
Filtration, facts concern'g, by C. Symes *395
Finger rings, gimmal *43
Firearms, manufacture of *25
Firearms, recoil motion, appar., to study *269
Firearms, small, manufacture of near Birmingham, England 50
Firebars, chain *244
Firebar, rocking, new *129
Fire blight on fruit trees, by T. J. Burrill 258
Firebox, Kaselowsky's *59
Firebox, locomotive, Pennsylvania R. R *21
Fire-brick and terra cotta, how made, by A. McL. Parker 208
Fire-damp, apparatus for measuring *192
Fire-damp detecter, acoustical, Forbes' *200
Fire-damp explosion, improved apparatus for preventing *305
Fire-damp in mines, apparatus for the detection of *255
Fire-damp photometer, Liveing's *253
Fire department, New York, celerity of *281
Fire engine, Gould's *27
Fire engine, steam, English *371
Fire escape, folding, Schwieger's *390
Fire engine pump, improved *120
Fire engine, steam, Flaud and Cohendet's *364
Fire engine, tug, and dredger combined *204
Fire engineer, the architect, and the underwriter, an address by Edward Atkinson. A valuable paper 250
Fire engines, how to get large streams from, *256
Fire extinguisher and alarm, automatic, Maxim's *350
Fire extinguisher, automatic, Grinnell's 410
Fire extinguisher, Fawcett's *420
Fire extinguisher, history of 358
Fire extinguishment, progress in 248
Firegrate, smoke-consuming, "Glow" *323
Firegrate, revolving, Barber's *54
Fire hazard, explosion as an unknown 288
Fire, how to prevent the rapid spread of 205
Fire, how produced among savage tribes *392
Fire, remarkable, caused by lightning 187
Fire risks of malting, fermentation, sizing, and dyeing 376
Fireplace, ventilating, improved *110
Fireproof buildings, suggestions for constructing, by Isaac P. Noyes 322
Fireproof construction *86
Fireproof construction, by F. Schumann, C. E.; a valuable practical paper *137, *138
Fireproof construction, by N. H. Hutton 10
Fireproof construction, by R. G. Hatfield 198
Fireproof flooring, plan for *70
Fireproof finish for fabrics 245
Fireproof houses, cheap; description of model fire-proof houses erected in Chicago *91
Fireproof paper and ink for documents 158
Fireproof tissues, especially curtains, ball dresses, etc 245
Fireproof towns of the River Plate 389
Firepump, steam, and fire extinguisher, Hemptinne's *327
Fires, carbonic acid gas as an extinguisher of 65
Fires, colored, for parlor theatricals, how to make 317
Fires, colored, used in pyrotechny, recipes for, by S. Kern 49
Fires, recent, and their lessons to fire departments and builders 372
Fire-screens in enameled sheet iron *103
Fire-screens, ornamental, how to make *318
Fire, smouldering, and spontaneous ignition; notes on some unconsidered causes of fires 227
Firework formulæ; colored lights; colored stars for rockets; rocket composition; composition for pin-wheels; 34 recipes 317
Fireworks, how made; general description of process *209
Fireworks, Japanese, how made 139
Fish culture. A practical paper, by G. Fennel, giving full directions for the construction of apparatus for breeding trout and salmon, for taking the eggs from the fish, impregnating them, etc *12
Fish-hatching apparatus, imp., Wilmot's *40
Fish-hatching apparatus, St. George's *410
Fish, living, apparatus for transporting, Hainmerle's *23
Fish, plaster casts of, how to make 126
Fish pond, how to make *240
Fish, relative value of as food 285
Fish, transparent *250
Fisheries Exhibition, International, Berlin, exhibit's at *236, *240
Fisheries Exhibition, London, 1883 ..... *385, 393
Fisheries Exhib., London, U.S. exhibit at *412
Fisheries of Japan 372
Fisheries, Spanish, at Fisheries Exhibition 421
Fishes, eye-like spots in, by F. J. Beli *301
Fishes, odd, at the Fisheries Exhibition *413
Fishing boats at the Berlin Fisheries Exhibition. 413
Fishing gear, improved *241
Fistula in ano, new method of treatment, by Dr. I. J. Sugg *411
Fitting-blocks, cast iron, for boilers, strength of 175
Flag, American, historical notes on *51
Flame, sensitive, apparatus for ordinary gas pressure 83
Flame, luminosity of, by Dr. W. Siemens *58
Flame, temperature of, by F. Rossetti 385
Flames, apparatus that permit of entering, by A. De Rochas 147
Flames, sensitive, effect of inaudible vibrations upon 360
Flanging machine, hydraulic, for boiler making 81
Flannel, electric, for rheumatism *300
Flask, sulph. of iron, for photographers 391
Flax and jute card and how it is made *425
Flax as a carrier of disease *145
Flax doubling, improvement in 289
Flesh and fat producers for cattle *367
Fleuss' new diving dress, by which a diver is enabled to remain under water for hours 302
Flight and its imitation, by F. W. Brearey *230
Floating dock, Lauria's 207
Floats for docking ships and raising sunken vessels 95
Flocking machine for yarn *130
Flooring, concrete *137
Flooring, fire-proof, Cozens-Hardy's 338
Flooring, fire-proof, plan for *70
Floors, best, for stables 66
Floors for horse stables, best materials for 308
Floors, how to construct 130
Floors, vaulted, mode of constructing *46
Flora of New Caledonia *21
Flora of North America, geological history of, by Dr. J. S. Newberry. A very interesting and valuable paper 245
Floral design, suggestions in, by F. Edward Hulme *15, *18, *28, *34
Florida, Gulf Coast of, as a residence for invalids, by R. J. Levis, M.D *371
Flounder, eyes of 71
Flour, analysis of; description of a simple method by means of which any one can easily ascertain for himself the food value of any sample of flour, by Dr. A. T. Cuzner *414
Flour and bread, improved process for the detection of alum in, by A. W. Blyth 329
Flour dressing, machine, Victor *173
Flour, fancy middlings, process of making 13
Flour from sprouted wheat, how to detect 422
Flour grinding, high, Austro-Hungarian; the Buda-Pesth mills 119, *137
Flour making, cost of power in 365
Flour, microscopical examination of; a method by which the fibers can be readily isolated, by Chr. Steenbuch 325
Flour mill, disintegrating, Carr *157
Flour mill, extensive, at Malters, Switzerland; full details of arrangement, with plans and sectional elevations *412
Flour mill machinery, cost and depreciation of, by A. J. Waters 202
Flour mill, Niagara Falls *156
Flour mill, Oliver Evans', of 1783 ..... *163
Flour mill, porcelain cylinder, Wegmann *377
Flour mill, roller, St. Paul *347
Flour mill, Washburn "A" *246
Flour mill, Washburn, explosion of, 1878 ..... *133
Flour milling machinery at the Paris Ex. *173
Flour milling, modern, in England, by Henry Simon 341
Flour milling, new process 111
Flour milling, new process, Jones' *115
Flour milling, origin of the new process of, by Albert Hoppin 275
Flour mills, American, needs of 256
Flour mills, explosion of at Minneapolis, cause, by S. F. Peckham 194
Flour mills, roller, by Oscar Oexle, C.E *39
Flour mills, roller, Gauz's Mechwart's *166
Flour mills, the steam engine as a motive power for, by J. F. Tallant, M.E 233
Flour roller mills and milling as practiced at Buda-Pesth, by W. B. Harding 341
Flour trade, American 240
Flour tester, or aleurometer *99
Flour, yield of, per horse power, by H. F. Weller. 67
Flower-pot stand in bronze, design for *55
Flower-pots and vases, turf, how to make, by A. D. Lee *17
Flowers and insects, geological antiquity of, by Dr. J. E. Taylor. A valuable and interesting paper 120
Flowers and insects, mutual relations of 298
Flowers and their unbidden guests 185
Flowers, artificial, luminous, how made *186
Flowers, etc., how to take copies of 64
Flowers, coloring matter of, by Prof. J. B. Schnetzler 287
Flowers, colors of, by Grant Allen 326
Flowers, double, the production of 284
Flowers, fertilization of by humming birds 225
Flowers, hardy, for midsummer, by William Falconer 299
Flowers, objects of sex and odor in, by Thomas Meehan 194
Flowers, sugar in the nectar of, by A. S. Wilson 145
Flues, boiler, corrugated, Fox's *293
Flumes and their construction *362
Flumes, lumber, of California *95
Flumes, lumber, mode of construction, etc. 116
Fluorescence, the phenomena of, by E. H. Hodges. An account of some of the more interesting and remarkable facts that have been learned in recent years in regard to the phenomena of "internal dispersion," along with historical notes on the earlier discoveries therein 255
Fluoric acid, its preparation and use in glass engraving 380
Flushing apparatus, intermittent, Cuntz's, *382
Flushing closet, automatic, Adams' *321
Flying machine, new, Lewis' *90
Flying machine, Simmonds' *6
Flying machines, a presentation of a few truths that are constantly overlooked by experimenters on these apparatus 371
Fly-wheel accident, with drawings, showing the faulty construction of the fly-wheel; the reasons for the breakage; with practical directions for the avoidance of such occurrences, by Joshua Rose *30
Fly-wheel accidents and their causes 38
Fly-wheels and pulleys, how to balance *221
Foam, dried, how to prepare, by R. Brooks *300
Fodder corn 134
Fodder, how to preserve *70
Foehn of Greenland 410
Fog signal, or siren, steam, Brown's *49
Fog signals, by J. R. Wigham 151
Fog signals, acoustic, experience with *12
Food adulteration, laws of Wisconsin ag'st 237
Food and energy of man, by Prof. De Chaumont, F.R.S 360
Food animals, chemical composition of, by Sir B. Lawes 397
Food, chemical investigation of value of 244
Food materials, recent modifications in the manufacture of, by J. W. Mallet 237
Food, new, for cattle 200
Food, physiology, and force, by Dr. E. L. Sturtevant. An interesting paper presenting many valuable and instructive facts. Food a form of force; the animal a product of force or forces; definition of "work;" the amount of force derived from various articles of food 186
Food preservation, Barff process 332
Food products, American, export of to England 199
Food products at Paris Exhib 145, 151, 155
Food products in tin, American, analysis 246
Food, relation of to muscular work, by Dr. W. B. Carpenter 339
Food, selection and preparation of, by Miss Ruth Smith. A valuable paper 271
Food, thrift in relation to, by Dr. B. W. Richardson 229
Foods, adulteration of, from the report of Dr. Smart to the National Board of Health 271
Foods, cereal, microscop. examination of *328
Foods, cost and comparative nutritive values of, by A. L. Murdock 124
Foods, curious 200
Foods for the sick, and their modes of preparation, by Dr. C. M. Seltzer 409
Foot-bridge, Manchester, open contract for *86
Foot-bridge over the River Ness *80
Foot-warmers, car, arrangement for heating, *176
Forage plant, a valuable 112
Force-blast blowers, Roots' *51
Force, transformation of, apparatus for demonstrating 28
Forces, parallelogram of, discussion on, by D. P. Blackstone *85
Forearm, a case of injury to, and recovery, by Dr. M. Case *424
Forest trees, insect destroyers of, by Mary E. Murtfeldt 131
Forest trees of Canada, northern limits of *390
Forestry, French experiments in 150
Forests, influence of on watercourses, by David D. Thompson 307
Forged checks, Sir Henry Bessemer's plan of color printing to prevent the alteration of financial paper 227
Forgeries, detection of by the microscope, by Prof. J. H. Wythe 258
Forgeries, photographic and otherwise, protection against, by John Spiller 240
Forges, smithy, steam blower for, Korting *39
Forging hammers, and stamps, Longworth's, *86
Forging mill, Saint Chamard; general description of the works, with plans, and illustrations of machinery *303
Forgings, large, from the Krupp factory, at the Centennial 27
Forts, armor plate, experiments on at Shoeburyness *406
Fossil bones, an address to, in a private museum, by J. S. Lippincott 268
Fossil fields of Southern Oregon, by C. H. Sternberg 427
Fossil footprints *21
Fossil forests of the volcanic Tertiary formations of the Yellowstone National Park, by W. H. Holmes *180
Fossil lovers, the; Bret Harte's madrigal and Ann Gelica's reply 225
Fossils, age of, possible sources of error in computing 348
Foundation, new, for Washington monument, construction of 227
Foundations, cylinder, excavator for sinking, Diack's *103
Foundations, new method of constructing, by O. C. Matthews *16
Foundations, pneumatic *218
Foundations, submarine; a description, with dimensions and scale drawings of the apparatus employed at Polar Harbor, Austria *30
Foundations, the various kinds of, and best way of dealing with them, by W. C. Street 323
Foundry, prehistoric, at Bologna 149
Fountain, bronze, design for *400
Fountain, circulating, Bourdon's; instrument for illustrating a law in hydrodynamics *389
Fountain for boiling wort, Pontifex and Wood's, *39
Fountain, Heron's *404
Fountain, mural, in majolica *163
Fourth state of matter, Prof. Ginti's refutation of the hypothesis of 260
Fourth state of matter, theory, a refutation of, by Dr. J. Puirig 246
Fowling-piece shot, velocity of, Mayer's experiments on 254
Fractures of the leg, new apparatus for, by Dr. O. J. Croskery *55
Fragrant woods, description of many 172
Frameworks, stresses in, graphic treatment of, by R. H. Graham, C.E *402
Franklin Search Expedition, American *269
Franklin's place in science 241
Franz-Josef Land, second voyage of the Eira to, by Mr. Leigh Smith 378
Freezing, explosions by *251
Freezing mixtures 252
Freezing mixtures, serviceable, recipes for 89
Fresco painting, designs by A. Schill *102
Fresenius, Prof. Karl Remigius, the chemist. Biographical sketch and portrait *318
Friction between tires and rails, diminution of, by D. McDowell *11
Friction experiments, first report on, by B. Tower *419
Friction gearing, Goubet's *337
Friction in solids and fluids *366
Friction machine for producing heat *271
Friction matches as a cause of fires 353
Friction, new investigation of one of the laws of, by A. S. Kimball 76
Fogs and their causes, by R. A. Proctor 173
Frost, glazed, how produced 175
Fruit culture, the latest advances in 165
Fruit essences, artificial, formulæ for making, by Prof. Maisch 196
Fruit evaporator, a good type of 132
Fruit, how to keep 159
Fruit houses, notes on 63
Fruit sirups, fourteen recipes for 293
Fruit sirups, recipes for, by F. W. Neynaber 23
Fruit trees, barren, potash for 390
Fruit trees, newly set, how to prune *109
Fruit trees, trained, French exhibits of *132
Fruits and vegetables grown in Florida, profits on 308
Fruits, how nature sweetens, by Dr. James R. Nichols 379
Fruits, cultivation of, useful hints on 349
Fruits, how to can and preserve 305
Fruits preserved with sugar; valuable recipes for marmalades or jams, fruit pastes, fruit jellies, and compotes and brandied fruits, by J. W. Parkinson 96
Fruits, small, by W. D. Philbrick 264
Fruits, small, culture of 386
Fruits, West Indian 298
Fry, Howard, railway engineer. Biographical sketch, with portrait *387
Fuchsin in Bright's disease 259
Fuchsins at the Jardin d'Acclimatation *308
Fuegians at the Jardin d'Acclimatation *308
Fuel, amount necessary to smelt ton of iron 83
Fuel, calorific power of; and on Thompson's calorimeter, by J. W. Thomas, F.C.S 288
Fuel, coal-dust, apparatus for burning *82
Fuel, coal refuse, machine for making *360
Fuel, comparative values of coal and gas as 216
Fuel, economy of, and prevention of smoke 160
Fuel, economy of in steam engines 39
Fuel-feeders, McMillan's *319
Fuel, gas as 175, 178
Fuel, gaseous, by L. T. Wright 427
Fuel, liquid, apparatus for burning, Leuts', Artemeff's, and Brandt's *403
Fuel, petroleum as 331
Fuel, tan-bark, machine for making, Masson's, *245
Fuel, water gas as, by G. S. Dwight 53
Fuels, liquid; abst. of paper by H. Aydon 119
Fuels, liquid, for steam engines, recent experiments with 238
Fulling machine, Huguenin's *305
Fulling mill improved *327
Fulling mills, waste water of, how to utilize, 181
Fungi, oxalic acid in, by W. M. Hamlet 92
Fur-bearing animals of Maine 316
Fur trade, N. American, history and progr 280
Furnace, automatically-fed, Rober's *271
Furnace, blast, anthracite, Weimer's *101
Furnace, blast, apparatus for charging, Weimer and Birkenbine's *13
Furnace, boiler, chain fire-bars for *244
Furnace, coal blast and petrol., Caldwell's *8
Furnace, coke, Seibel's *381
Furnace, continuous, for gas distillation, Parcot's *226
Furnace, crucible, improved *143
Furnace, crucible, oscillating, Piat's *211
Furnace, crucible, portable, Piat's *133
Furnace, crucible, repair of while in blast 34
Furnace, new, for decomposing salt with sulphuric acid, by R. C. Clapham 20
Furnace for burning refuse and street sweepings, Fryer's *283, *362
Furnace for burn'g sulphur, Hemptinne *327
Furnace for tempering steel, improved, Armstrong's *13
Furnace for the combustion of bituminous coal without smoke, Hoyt's *71
Furnace for the combustion of refuse matter of cities *191
Furnace, for gold and silver extraction, Fryer, *11
Furnace, gas, Boetius' *85
Furnace, gas, Casson's *38
Furnace, gas, for refractory products *360
Furnace, gas, laboratory, Griffin's *20
Furnace gases, apparatus to determine, Bunte's *393
Furnace gases, removal of noxious vapors 299
Furnace, glass, Richman's *137
Furnace grates, smokeless, Regan's *86
Furnace, new, for iron and steel, Lyttle's *24
Furnace, puddling, Abbott's *140
Furnace, puddling, Casson-Dormoy *25
Furnace, puddling, new, Middleton's *33
Furnace, puddling, retort, Price's *108
Furnace, regenerating, Ponsard's *148
Furnace, shaft, for refining cast iron *248
Furnace slag, some new uses of 199
Furnace, smoke-consuming, Gowthorpe's *320
Furnace, smoke-consuming, new *424
Furnace, smoke-consuming, tests of a 228
Furnace, sulphide of carbon, Labois' *299
Furnace-feeder, new, Smith's *138
Furnace-feeder, Schultz's *159
Furnaces, Bicheroux system of, applied to the puddling of iron *344
Furnaces, blast, of Bethlehem, Pa., Iron Works, *93
Furnaces, blast, of Great Britain 18
Furnaces, blast, process of applying oxygenated air in, Hornbostel's 83
Furnaces, blast, substitution in of liquid vaporized and gaseous hydrocarbons for solid fuel, by C. Pilagge *3
Furnaces, boiler, combustion of coal in 191
Furnaces, combustion in, heated air for 107
Furnaces, crematory, Siemens' *264
Furnaces for rivet-heating, Bouchacourt and Delille's *66
Furnaces, foundry, portable, Platt's *180
Furnaces, gas, Bicheroux's *6, 84
Furnaces, gas generating, by F. Lurmann *251
Furnaces, gas, new method of distributing flames in, Klattenhoff's *396
Furnaces, glass, and others, by C. Coine 201
Furnaces, hot-blast stoves for, Cowper's *235
Furnaces, hydrocarbon, impr., Ramsden's *8
Furnaces, ore, improved, Eames' *45
Furnaces, regenerative, for gas retorts *401
Furnaces, revolving, improved, Godfrey and Howson's *101
Furnaces, smoke-burning, by F. C. Smith *420
Furnaces, steam boiler, for smoke prevention, by Jno. W. Hill, C.E 213
Furnaces, steel-melting, new, in Russia 122
Furniture, Chippendale *389
Furniture, dining room, designs for *342
Furniture, English, old *422
Furniture, English, examples of *391
Furniture, home-made, or what may be done with a few sticks. Beautiful furniture from ordinary materials. Two examples of fire screen, book rack, card stand, stand or pedestal for stationary, plaques, etc. All easily made *318
Furniture, parlor, cheap, designs for *395
Fusing disk, Reese's *260

G

Galenus, Claudius, writings of, by Dr. George Jackson Fisher 305
Galileo and the Inquisition 173, 175
Galley, Venetian, the Bucentaur *62
Gallery of Victor Emmanuel at Milan *314
Galleries of the Institute of Painters in Water Colors, London *400
Gall-fly, rose *428
Gallium, new metal 128
Gallium, new metal, by L. de Boisbaudran 5
Gallium, new metal, discovery of *27
Galveston harbor, Texas, improvement of *16
Galvani, Luigi. Brief biographical sketch, with engraving of the statue erected to him at Bologna 224
Galvanic batteries, a description, with illustrations, of nearly all of the different kinds in use, by G. M. Hopkins *157, *158, *159
Galvanic batteries, descriptions of several new forms—Slater's, Howell's, McCarty's, Ergstrom's, and Gutensohn's 238
Galvanic batteries, (see Batteries).
Galvanic combinations, different, chemical energy and electro-motive force of, by Julius Thomsen 279
Galvanism, medical uses of; abstract of a clinical lecture by Prof. Henry G. Piffard, M.D 15
Galvanizing iron wire, zinc bath for *34
Galvanizing, or the process of coating articles with lead 265
Galvanizing process for iron 176
Galvanization of iron, zinc bath for *161
Galvanometer, aperiodic, new form of, Deprez's *346
Galvanometer, astatic, Deprez's *308
Galvanometer, bifilar, Wiedemann's *421
Galvanometer, Deprez's *241
Galvanometer for demonstrating the internal current transmitted through the liquid within a voltaic cell, by C. W. Cooke, C.E *200
Galvanometer, mirror, convenient arrangement of, by A. F. Delafield *126
Galvanometer, or ampere-meter, solenoid, Blyth's *389
Galvanometer, Sabine's *361
Galvanometer, simple, Dubois' *371
Galvanoscope, the most sensitive, by Prof. E. Von Fleischl. Description of the position, appearance, and general properties of the nerves and muscles of a frog, and of some experiments that may be performed therewith *416
Gamgee's ammonia engine *281
Gang mill, iron frame, Wickes' *401
Gangrene, treatment of by hot water 176
Gap-lathe, screw cutting, Thuillier's *375
Garden, flower, color in *427
Gardens, by Peter Henderson. Valuable instruction for the cultivation of many kinds of vegetables and small fruits 134
Gardens, floating, of Lake Srinagar, India *287
Gardens, public, Victoria, London *305
Gas absorber, improved, Gore's *128
Gas analysis, Goodwin's method of *111
Gas, analysis of, apparatus for, Orsat's *250
Gas and coal, comparative values of the fuel of the future; curious speculations about the wastes of coal, by Geo. S. Dwight 216
Gas and coal fire grate, Siemens' *266
Gas and electricity as heating agents 276
Gas and electricity, facts about 259
Gas and electricity, the light and energy of, by J. T. Sprague 192
Gas and gas making. An interesting and instructive paper, by L. P. Gratacap, Ph.B., giving a detailed account of the materials and apparatus used in making illuminating gas, and also of the process of manufacture 188, 192, 199

Gas and gas making, by Samuel Dalziel....313
Gas and water mains, hydrostatic joint for.*109
Gas, apparatus for heating by, Gomez's....*417
Gas as fuel....175, 178
Gas as fuel for fire-grates....259
Gas washer and scrubber, Anderson's....*192
Gas blowpipe, Wenham's....*200
Gas burette, simple, Bunte's....*101
Gas burner analyzer....*336
Gas burner, Clamond's....*408
Gas burner for heating purposes, Ehret's....*29
Gas burner for singeing machines, new....*417
Gas burner, Marini and Goegler's....*302
Gas burner, new and remarkable, Wallace's.. 57
Gas burner, new, Grimston's....*362
Gas burner, rheometric, Giroud's....*200
Gas burner, Siemens'....*271
Gas burner, Terquem's....*293
Gas burner, the Phare....*271
Gas burners and heaters, Defty's....*362
Gas burners, app. for lighting, Klinkerfues'.*331
Gas burners, by J. Pattinson; results of tests of various Argand, batwing, and fishtail forms. 19
Gas burners, by William Sugg. A valuable paper, containing important suggestions regarding construction of burners and the use of gas...359
Gas burners, improved, Sugg's....*174, *249
Gas burners, regenerative, Siemens'....*301
Gas, carbonic-acid, as a fire extinguisher.... 65
Gas, coal, as fuel for boilers, advantages of, by L. Paulin....153
Gas, coal, and smoke, economic washing of..315
Gas, coal, heating power of....216
Gas, coal, new residual product from....428
Gas, coal, new products obtained from: ponsecilon, a new pigment, and cyanon, a new gunpowder, by Lewis Thompson....120
Gas, coal, the relative illuminating value of the vapors and gaseous hydrocarbons in, and quantitative determination, by G. E. Stevenson.*251
Gas, coal, use of, for lighting and heating, by Prof. Armstrong....335
Gas-coal, the necessary requisites of, by J. Macfarlane....123
Gas, condenso-purifier for, Chevallet's....*363
Gas, crude, removal of ammonia from....388
Gas distillation, furnace for, Farcot's....*226
Gas and electric light apparatus, exhibition at Glasgow....259
Gas and electricity, the competition between, in Paris....221
Gas engine and producing plant, Dowson's.*411
Gas engine, Clerk's....*310
Gas engine, cost of working, by F. J. Linton.248
Gas engine, earliest, historical notes on....417
Gas engine, Edwards'....*404
Gas engine, Ewins and Newman's....*360
Gas engine, new, Crossley's....*117
Gas engine, Otto's....*282
Gas engine, silent, Otto's....*146
Gas engine, theory of....336
Gas engine, Turner's....*218
Gas engine, Wordsworth's....*380
Gas engines at the Paris Electrical Exhib'n.307
Gas engines, improved, Cropper's....*95
Gas engines, improved, Gilles'....*44
Gas engines, economy of, by Prof. Ayrton....316
Gas engines, 16-horse, Otto's....*190
Gas exhauster and engine, Roots'....*51
Gas exhauster, improved....*299
Gas flames, light and heat in, by Dr. T. O'C. Sloane....169
Gas flames, luminous and non-luminous, by G. E. Stevenson....352
Gas for motive power, new method of heating, by W. N. Hill....*39
Gas for producing electric lights....183
Gas from petroleum for passenger cars....117
Gas furnace, Boetius'....*85
Gas furnace, Casson's....*38
Gas furnace to bake refractory products....*360
Gas furnace, laboratory, Griffin's....*20
Gas furnaces, Bicheroux's....*6, 84
Gas furnaces, new method of distributing flames in, Klattenhoff's....*396
Gas generating furnaces, by F. Lurmann.*251
Gas generator and blowpipe, Thomson's. *95
Gas generator, new, Siemens'....*309
Gas generators, Krupp's....*310
Gas heated boiler, multitubular....*263
Gas, heating, by W. H. Edgerton....*378
Gasholder tanks, brick and concrete, and simple concrete, by W. H. Edinger....*306
Gasholder, telescopic, French; details of construction, with figures showing plan and sectional elevation....*290
Gas, hydrogen, new process and apparatus, Tessie du Motay's....*241
Gas, illuminating, apparatus for verifying the illuminating power and density of....*336
Gas, illuminating, experiments with different qualities of used in an Otto gas engine, by Chas. Hunt, C.E....346
Gas, illuminating, apparatus, Daix's....*349
Gas, illuminating, from petroleum, improvements in the manufacture of; description of process and apparatus employed at Utica Gas Co.'s works, by T. S. C. Lowe....*2
Gas, illuminating power of, by W. Sugg,.... 14
Gas, illuminating power of, influence of atmospheric rarefaction on....320
Gas, illuminating power of, method of increasing, by V. Popp....*392
Gas, illuminating, sulph. hydrogen and carbonic acid in, estimation of, by L. T. Wright....*330
Gas illumination, historical notes on....268
Gas indicator or manometer, Brouardel's. *299
Gas kiln, Thompson's....314
Gas lamp, incandescent, Clamond's....*351
Gas for lighthouse signals....330
Gas, light-power and density, app. to verify.*336
Gas light, waste of....125
Gas lighter, electric, Bogart's....*44
Gas lighting apparatus, electric....*213
Gas lighting arrangement of the residence of W. H. Vanderbilt....*331
Gas lighting by electricity....*29
Gas lighting, possibilities in....166
Gas lighting, regenerative, a lecture by F. Siemens, giving an account of Siemens' devices for increasing the illuminating power of gas*.219
Gas liquor from gas works, Solvay's apparatus for concentrating, by Dr. G. T. Gerlach....*77
Gas, machine for pumping direct into the mains. *231
Gas machine retort, new, Van Kannel and Towsley's....*1
Gas mains, jointing and testing, by C. W. Folkard, 394
Gas making app. Wilson's and Dowson's,*339
Gas making; a new mode of working washers and scrubbers, by R. H. Patterson....74
Gas making, limed coal in, by J. A. Wanklyn. 399
Gas making, peat as a material for....419
Gas manufacture, carbonizing apparatus for, Carpenter's....*144
Gas manufacture, chemistry of, by A. V. Harcourt. A short account of the formation and chemical nature of coal and the result of applying heat to it, especially in connection with the manufacture of illuminating gas....72
Gas manufacture, improvement in, Olney's..*13
Gas manufacture, progress and improvements in, by J. Hall....140
Gas motor, Benier's....*289
Gas motor, Forest's....*426
Gas motor, Lang and Otto's....*27
Gas motor, Ravel's....*276, *313
Gas motors and producers, Siemens'....*324
Gas motors, Bottcher's....*302
Gas motors, Buss, Sombart & Co.'s....*265
Gas motors, efficiency of as compared with steam, by Thomas Holgate....368
Gas, natural, in iron making....72
Gas, oil, compressed, for lighting cars and steamboats....*324
Gas, oil, retort for, Drescher's....*310
Gas pressure regulators, electric, systems of Launay and of Chardin....*214
Gas, pressure-gauge for, improved....*76
Gas process, Lowe, a question in gas chemistry, 98
Gas process, Lowe, as used at Baltimore....114
Gas process, the Lowe....53
Gas producer, Tessie....*240
Gas, production and use for the purposes of heating and motive power, by J. E. Dowson....334
Gas purification, new processes of, based on the utilization of its impurities in the production of commercial salts, by G. Valentine....*305
Gas purifier, M M. Pelouze and Audouin's.*234
Gas purifier, Still's....*58
Gas regulator, improved....*108
Gas regulator, improved, for burners, by D. B. Peebles....*144
Gas retorts, regenerative system of firing.*401
Gas retorts, methods of setting.*22, *43, *98
Gas scrubber-washer, Saville's....*65
Gas scrubbers at Manhattan works....*206
Gas and steam motor, Simon's....*182
Gas, sewer, a theory of, by Dr. P. H. Van der Weyde....245
Gas, sewer, and its dangers, by Dr. G. W. McCaskey....481
Gas, steam, and air engine, Simon's....*168
Gas, storage of, James' method....282
Gas stove, See's....*415
Gas stoves, apparatus for regulating temperature of....*263
Gas stoves, by Dr. James Adams....228
Gas-tar pump, improved....*89
Gas tell-tale, explosive, Weber's....*296
Gas, the purification of by ammonia, by F. D. Marshall....*320
Gas, transmission of, apparatus for, Newman and Duesbury's....*137
Gas verifier, Giroud's....*34
Gas vs. steam as a motive power....322
Gas, water, advantages of, by G. S. Dwight.. 60
Gas, water, as fuel, by G. S. Dwight....53
Gas, water, as fuel, abstract of a paper by Prof. Von Marx....364
Gas, water; description of apparatus for producing cheap gas, and some notes on the economical effect of using such gas with gas motors, etc., by J. E. Dowson, C.E....303
Gas, water, in America, and how made, by Dr. A. P. Hallock....*398
Gas, water, manufacture of, by G. E. Stevenson. *311
Gas well, Wyandotte, Kansas....90
Gas wells of Pennsylvania, by Prof. J. Lawrence Smith....28
Gas works of Brussels, Belgium....245
Gas works, portable, Wren's....*98
Gaseous fuel, by L. T. Wright....427
Gases, absorption of, by charcoal....171
Gases, action of bacteria on....281
Gases, apparat. for extraction and analysis.*332
Gases, centrifugal apparatus for purifying, Braun's....*173
Gases, compression of, by Charles F. Brush, M.E.; description of some new apparatus for the compression of gases to a very high degree.*19
Gases, compressed, explosion of vessels containing....411
Gases, continuous preparation of, apparatus, for....*325
Gases, density of, rapid method of determining, by C. Chancel....*351
Gases, electric discharge in....245
Gases, explosive, ignition of, researches on.407
Gases, furnace, app., to determine, Bunte's.*393
Gases, furnace, burette for the analysis of, Bunte's....*360
Gases, liquids, and solids, by W. Mattieu Williams. 329, 330
Gases, liquefaction of, Cailletet's apparat..*128
Gases, noxious, indicator for, Coquillon's.*102
Gases of roasting furnaces, removal of noxious vapor from....299
Gases, on the viscosity of at high exhaustion, by Wm. Crookes....277
Gases or vapors, liquefiable matter in, apparatus to condense, Pelouze and Audouin's....*57
Gases, solubility of solids in, by J. B. Hannay and James Hogarth....225
Gases under high pressure, apparatus for determining the volume of, Cailletet's....*172
Gastornis, skeleton of, recent discovery....*348
Gastric julce, effect of alumina salts on in the process of digestion, by H. A. Mott, Jr....214
Gastrotomy in stricture of the œsophagus, with report of a successful case by Prof. F. Trendelenburg of Rostock, by W. Thomson, M.D..*147
Gate, in wrought iron, designed by Narten..*70
Gate, iron, design for....*241
Gate, iron, in Rennes, Bretagne....*264
Gate, wrought iron, design of Eisenlohn and Weigle....*329
Gate, wrought iron, from the Imperial Office of Justice in Berlin, by Von Moerner....*335
Gates, wrought iron, Guildhall, Worcester.*303
Gateway, iron, ornamental.—Grilles, wrought iron, in St. Giles' Church, Lubeck....*411
Gauge, electric, Mercadier's....*329
Gauge for tubes, Goulier's....363
Gauge, pressure, Bourdon's....*70
Gauge, pressure, for gas, improved....*76
Gauge, rain and snow, recording, Draper. *209
Gauge, rain, simple, how to make....*419
Gauge, speed, Osborne's....*200
Gauge, steam, recording, Edson's....*70
Gauge, water, alarm....*245
Gauge, water, for boilers....*272
Gauge, water, Nicholas'....*41
Gauges, steam and air, Nedden's....*197
Gear cutter, bevel, Grube's....*29
Gear cutter, Corliss'....*50
Gear cutters, equidistant, by Prof. C. W. MacCord. A paper describing the epicycloidal system of making spur wheels interchangeable....*333
Gear cutting apparatus for....*317
Gear motion, irregular, a practical improveme't in....*419
Gear wheels necessary to cut a thread in a screw cutting lathe, how to calculate, by Joshua Rose....28
Gearing, central friction, Goubet's....*337
Gearing, elliptical, by Prof. C. W. MacCord. Plain instructions and numerous diagrams, from the study of which any careful draughtsman will be able to lay out elliptical gear wheels in such a way as to satisfy all the requirements of practical mechanism....*2
Gearing, improved, Smith's....*45
Gearing, toothed, a new form of elliptical bevel wheels, by Prof. C. W. MacCord. An interesting mathematical and mechanical study....*141
Gearing, worm, Hawkins'....*104
Gelatine, apparatus for manufacturing at a temperature below the boiling point of water, Zwillinger's....*258
Gelatine bromide, preparation of, Bascher's process....248
Gelatine dry plates, Eastman, Roche's method of developing....301
Gelatine emulsion, a new method of making, by W. K. Burton....303
Gelatine emulsion, chloride of silver, by H. L. T. Haakman....278
Gelatine emulsion, excess of nitr. silver in. 295
Gelatine emulsion for amateurs....226
Gelatine emulsion for direct printing....336
Gelatine emulsion, how to keep....224
Gelatine emulsion, how to prepare for the gelatino-bromide process....*193
Gelatine emulsion, Houlgrave's....183, 211
Gelatine emulsion, method of washing, by William England....318
Gelatine emulsion, new discovery regarding, by L. Warnerke....292
Gelatine emulsion, new method of preparing, by Franz Stolze....358
Gelatine emulsion plates, by H. J. Palmer... 51
Gelatine emulsion, prep. of with glycerine..214
Gelatine emulsion process, Bennett's....175
Gelatine emulsion process, modified, by W. K. Burton....*374
Gelatine emulsion process, sensitive....122
Gelatine emulsion process, theory of, by Dr. H. W. Vogel....231
Gelatine emulsion, substitute for ground glass. Improved mode of photo-engraving; gelatine emulsion solutions for developing gelatine plates; photo paint for machinery....366
Gelatine emulsion with the addition of resin, by Fr. Wilde....295
Gelatine emulsions and plates for photography, practical hints on the manufacture of, by W. K. Burton....330
Gelatine, explosive, Nobel's tests of....341
Gelatine, impurities in....264
Gelatine jelly as a dialyzer, by R. C. Woodcock, 335
Gelatine, methods of producing and purifying. 320
Gelatine negatives, retouching, by William Shawcross....295
Gelatine negatives, washing and fixation of.381
Gelatine paper, aniline fuming for....226
Gelatine plates....301
Gelatine plates....180
Gelatine plates, alkaline development of....228
Gelatine plates, apparatus used in Berlin for the preparation of, by Franz Stolze....*299
Gelatine plates, development of....230
Gelatine plates, development of, by W. T. Wilkinson....258
Gelatine plates, how English operators work, by J. H. Taylor....313
Gelatine plates, enlargements on, by William Brooks....373
Gelatine plates, how to develop....239
Gelatine plates, how to dry....348
Gelatine plates, how to prepare....226
Gelatine plates in the studio, by F. P. Moffat.238
Gelatine plates, method of coating....*369
Gelatine plates, methods of intensifying and reducing, by E. H. Farmer....382
Gelatine plates, practical methods of intensifying with silver....377
Gelatine plates, preparation, by F. Dawson. 180
Gelatine plates, preparation of, by E. Howard Farmer. Glass, pictures on, M. E. Godard...384
Gelatine plates, preparation of in the studio.269
Gelatine plates, sensitizing of by caustic potash, by A. Stosch....333
Gelatine plates, notes on, by E. Brightman..281
Gelatine plates, streaks in....297
Gelatine process of enlarging, by H. J. Palmer. Gelatine bromide tissue, Photogravure....269
Gelatine processes....174
Gelatino-bromide emulsion, by Rev. H. G. Palmer, M.A....*19
Gelatino-bromide emulsion with bromide of zinc....388
Gelatino-bromide of silver, by D. Van Monckhoven. A valuable paper....*205
Gelatino-bromide of silver, new method of preparing....194
Gelatino-bromide plates, by A. J. Jarman.190
Gelatino-bromide plates, new mercuro-cyanide intensifying process for....340
Gelatino-bromide process. Wet collodion process. Printing processes....351
Gelatino-chloride of silver pictures by development, by B. J. Edwards....336
Gem forms of corundum....61
Gems, artificial, how manufactured....100
Generator, steam, Herreshoff....*169
Gentian, a new species of....*333
Gentiana ornata....*413
Geodes, how produced and where found....208
Geodesie and astronomic connection of Algeria with Spain, by Commandant Perrier....*228
Geographic stadiometer, Bellomayee's....*38
Geography; address by C. R. Markham, 199, 200
Geological chart and zoic calendar of creation, by H. A. Reid....313
Geological facts recently observed in Montana, Idaho, Utah, and Colorado, by Dr. J. S. Newberry....316
Geological Museum of Columbia Col'ge School of Mines, by Israel C. Russell....190
Geological survey, U. S., second annual report, notes on, by L. P. Gratacap....413
Geological time, an estimate of....138
Geological time, recurrence of certain phenomena in. An address by Andrew Crombie Ramsay, LL.D., before the British Assoc....248
Geology and botany of the country bordering the Rio Grande in Texas and Chihuahua, by J. S. Newberry....411
Geology, experimental....201
Geology, experimental, artificial production of pisolites and oolites; and on crystals of anhydrous lime....*286
Geology, experimental, synthetic studies of, Daubree's....*229
Geology of New Jersey....386
Geology of the Palisades, by A. E. Hoppock.316
Geology of the polar regions....129
Geology of the West, by J. Van C. Phillips....90
Gestation of domestic animals....246
Geyser region in the National Park, by Dr. Otto Kuntze....245
Giants and dwarfs....*255
Gilding and plating on glass and porcelain, method of....86
Gilding by simple immersion, methods of....423
Gilding, electro, full directions for....160
Gilding metal surfaces....222
Gills, combs, and hackles....*187
Girder, bowstring, determination of stress in, by Lieut. G. S. Clarke....70
Girders, compression, cast iron, experiments with a new form of....*297
Girders, continuous....87
Glacial epoch, climate of the....1
Glacial observations in the Wind River Mountains, by C. F. Blackburn....268
Glacial period, causes of, by R. B. Cook....427
Glacial period in Illinois....400
Glaciation, ancient, in North America, evidences of, and their bearing on the theory of an ice period, by Dr. J. S. Newberry....419
Glaciers and icebergs, a new study of....342
Glaciers, causes of the motion of, by W. R. Browne....398
Gladioli, how to raise from seed....354
Glass, a simple method of drilling....324
Glass and porcelain, gilding and plating on, process....86
Glass as an construction of light....272
Glass blowing, by means of compressed air, Apperts' system....*399
Glass, buildings in....*136
Glass, "crackle," how to produce....358
Glass, etching, bath for....169
Glass, electrical resistance of at low temperatures, by G. Foussereau....352
Glass, flint or crystal, composition and mode of manufacture....221
Glass for decorative purposes, manufacture of, by H. J. Powell....*295
Glass furnace, gas, Rickman's....*137
Glass houses, construction of....424
Glass, how to draw upon....44
Glass, how to engrave upon....*318
Glass, how to etch with hydrofluoric acid.... 7
Glass, how to pierce with electric spark...*212
Glass, how to print upon....176
Glass, how to print upon, by J. L. Wells....*47
Glass, improvements in manufacture of, by J. W. Mallet....232
Glass, how to silver....121
Glass, how to silver; best method of silvering mirrors and other articles of glass, by the processes of Chapman, Siemens, Petitjean, Draper, and Lavat....105
Glass manufacture, description of Siemens' improvements in the manufacture of annealed, hardened, and toughened glass, and of the apparatus employed therefor....*256
Glass, manufacture of, description of Siemens' improvements in, with figures of new melting tanks, furnaces, moulds, etc....*249
Glass, manufacture of, in connection with blast furnaces....45
Glass melting ovens, notes on....116
Glass of Murano, ancient and modern, by James Jackson Jarvis....412
Glass, pictures in, designs for....*370
Glass plates and lenses, how to make....97, 81
Glass, plate, how made....340
Glass, plate, manufacture of....238
Glass ruling, action of diamond in....412
Glass, silvering, Leclerc's process....324
Glass, soluble, use of in the textile industry, by H. Grothe....89
Glass specula, new method of grinding, by Prof. Elihu Thomson....*141
Glass stoppers, fixed, how to remove....372
Glass, toughened, application of to permanent ways, by C. Wood, M.Inst.C.E....*207
Glass, window, manufacture of....366
Glass works, Val. St. Lambert; description of the establishment and mode of operating...*404
Glasses and mirrors, process of ornamenting by photography....224
Glasses, use of, to cure constitutional disease, by D. B. St. John Roosa, M.D....252
Glauber's salt, production of....254
Glazing, sizing, and stretching machine for warp....287
Globe, geographical, Browne's....*7
Globe, revolving, Redier's....*408
Globes, great, of French National Library...*3
Globes, time, Juvet's....*257
Gloves, dyes for, several recipes....108
Glucose and grape sugar, process of manufacture, by O. Luthy....96
Glucose from corn, manufacture of, Hirsh process....259
Glucose, report on, by O. E. March....424
Glucose, the Wolff, Furbisn, and Pigeon processes....*260
Glucose, what is?....292
Glue, liquid, recipe for....14
Glutine for stiffening and grossing calicoes, wall paper, etc., recipe for....176
Glycerine, evaporat'n of, by G Couttolenc.314
Glycerine in the fixation of indigo in dyeing, by M. Prudhomme....116
Glycerine, its preparation and uses; a comprehensive paper, by Dr. A. Bergbaus....380, 390
Glycerine, new test for, by A. Senier, M.D., and A. J. G. Lowe....147
Glycerine, physiological and therapeutical properties o., by A. Catillon....130
Glycerine, use of in weaving, dyeing, printing, and finishing, by H. Herberger....108
Goat and its commercial products....7
Gold, a new alloy as a substitute for....19
Gold and its manufactures; watch-cases, their uses, materials, and qualities....333
Gold and silver extraction, Fryer's process..*11
Gold and silver extraction, Secor process of. 57
Gold and silver metallurgy in the United States, progress of, by T. Egleston....333
Gold and silver ores, Paul's process of working. *38
Gold and silver parting, Gutzkow process..*325
Gold and silver, the present large supply of and its effects....39
Gold assays, apparatus for boiling, by W. F. Lowe....*381
Gold bearing rocks of Australia, by J. E. Richter. 371
Gold bluffs, and gold beaches on our northern coast....301
Gold, divisibility of, by H. G. Hanks....118
Gold find in California, original, Sutter's account of....420
Gold fine, why it floats....53
Gold, genesis and distribution of, by Prof. J. S. Newberry....329
Gold, how to recover from solutions....95
Gold in a specimen of gold in quartz, how to find the weight of....305
Gold in emulsion, by Henry J. Newton....113
Gold in Newfoundland....268
Gold in quartz, simple method of detecting. 319
Gold leaf, how made....253, 378
Gold mines of Plumas Co., Cal....68
Gold mines of Siberia....*326
Gold mining at Steubenville, O....72
Gold mining, by Thomas Price....319
Gold nuggets of remarkable size....61
Gold quartz specimen, Australian, of remarkable size....*29
Gold reducing machinery, Jordan's....*322
Goldsmith work, remarkable example of, in a sepulcher in Palestrina....67
Gold varnish for brass and bronze, recipe.... 15
Gold washing at Yesso, Japan....14
Gold wire, how made....340
Gongs, Chinese, how made, by G. W. Yapp. 85
Goniometer, reflecting, Pisani's....*30
Goose-quill, modern uses of....8
Gorilla and chimpanzee at the Crystal Palace, London....*217
Gorilla, the....*271
Gould, Jay, residence and conservatory of on the Hudson....345
Gould, John, the ornithologist. Biographical sketch of....279
Gour, the ruined capital of Bengal....277
Gourami, or nest-building fish....72
Governor for marine engines, Rankin's..*136
Governor, gas, automatic, White's....*137
Governor, marine, Durham's....*151
Governor, marine, Jenkins and Lee's....*260
Governor, steam, Andrade's....*115
Governor, steam, Bourne's....*114
Governor, steam, Hartwell's....*57
Governor, steam, Ide's....*424
Governor, steam, improved, Marks'....*28
Governors for marine engines, new....*269
Governors, gas, White's....*137
Graduates, young, some practical hints to, by Boardman Reed, M.D....290
Grafting wax, liquid, recipe for....70
Grafting, directions for....122
Grain crusher, Van Hörde's....*59
Grain cutters, Pini's and Willhelm's....*173
Grain dressing machinery, Vangelder's..*102
Grain drying machine, Roper's....*45
Grain elevator, American, in London....*220
Grain elevator at St. Louis....*79
Grain elevator, Behrns and Unruth's....*299
Grain elevator, pneumatic, Renhaye....*133
Grain elevator, Poulson's....*411
Grain elevator, Rennie's....*231
Grain separating machines, Marot's....*382
Grain separator and grader, Millot's....*170
Grain warehousing machinery, Ellington's. *378
Grain, when to cut....88
Grain weighing machine, automatic, Baxter's....*45
Grange, Little Tew....*284
Granite, how polished....124
Grape bags, improved, Pelletier's....*360
Grape crop of California....164
Grape culture, rules for....132
Grape culture under glass, by John Don...110
Grape sugar and glucose, manufacture of, by O. Luthy; conversion, neutralization, and evaporation and purification of the liquor; manufacture of glucose by means of malt; the apparatus, chemicals, and practical instructions for these processes....96
Grape sugar, crystallized anhyd. by A. Behr.337
Grapevine, a new enemy of....*173
Grapevine disease, remedy for....62
Grapevine, largest in the world, shown at Centennial....*31
Grapevines, American, in Southern France.—Grapevine, a remarkable example of....*374
Grapevines, propagation of....57
Grapes, distances for....198
Grapes, house, for different seasons of the year. 116
Grapes, how to manage....45, 57
Grapes, newer varieties of....199
Grapes of California....282

Graphical determination of the volume and surface of bodies generated by revolution, by Walter G. Berg *108
Grapnel for submarine cables, Jamieson's. *112
Grass and weeds, how to destroy 206
Grass crop, methods of seeding for 283
Grass, culture of, by A. F. Stevens 186
Grass, twitch, how to destroy 40
Grasses, American, composition of, by C. Richardson 336
Grasses of New Zealand, valuable 246
Grass trees of Australia *423
Grasses and leaves, how to skeletonize and crystallize 270
Grasses for lawns 414
Grate, fire, revolving, Barker's *54
Grate for gas and coal, Siemens' *266
Grates, furnace, smokeless, Regan's *86
Gravel drier, Duish's *7
Gravity, lunar disturbance of 314
Gray, Asa, the eminent American botanist. Sketch of life and labors, with portrait *207
Grease, extraction of from wool; description of a process by means of which the raw material may be treated so as to yield not only a better quality of product, but also a substance of great value to both the woolen manufacturer and the leather dresser 261
Grease traps *32
Great Salt Lake, by M. E. Jones 413
Grecian antiquities *421
Greenheart, Demerara, in shipbuilding 418
Greenhouse and grapery short description of such kinds of grapes as are best adapted for culture under glass 40
Greenhouses, benefit of solar heat in 105
Greenhouses, cheap, and how to heat them, by Peter Henderson; how to obtain perfect draught, excellent plan for furnace construction, etc *62
Greenhouses for lettuce growing, structure of, by W. D. Philbrick 304
Greenhouses, how to build *141
Greenhouses, small; description of several greenhouses, with cost, modes of heating, ventilation, etc., with some improvements 150
Greenland expedition, Nordenskjold's *409, *414, *422
Green Mountains, the age of 228
Gregynog Hall, Eng *372
Griffiths, Robert, "father of screw propellers." Biographical sketch 396
Grille, iron, for door-head; also portion of screen from the chapel of St. Anastasia, Verona *145
Grille, wrought iron, and cast iron stairs, designed by Messrs. Kropf and Diebitsch *60
Grilles, wrought iron, designed by A. Narten; lamp post, by W. Wollaneck *44
Grindelia robusta as a remedy in rhus poisoning 95
Grindelia robusta as a remedy in asthma, by Dr. T. M. Rochester 285
Grinding and polishing, by Joshua Rose. A valuable paper, giving a thorough description of all the appliances employed in grinding and polishing metals, with directions for use *31, *34
Grinding and polishing machine, stone *261
Grindstones of the sixteenth century *56
Grip-car for wire cable system, Chicago *334
Grooving, turning machine, etc., Atock's *23
Ground-air in its hygienic relations, by Dr. Max von Pettenkofer. An important and valuable paper, proving by experiment the existence of underground air-currents; and dangers from the escape of underground air into dwellings *82
Gulf of Mexico, basin of, by J. E. Hilgard 289
Gulf Stream, source of, by Dr. J. E. Nagle 95
Gum, superior, how to make 159
Gum lac, Arizonian, analysis of, by J. M. Stillman 231
Gums, new solvent for 220
Gums, resins, and waxes, notes on, by C. G. Warnford Lock 300
Gum tree, sweet, by Prof. Lawrence C. Johnson. An interesting and useful paper 383
Gun, Armstrong, 100-ton, at Spezia *93
Gun barrels, how to clean from lead 232
Gun, breech-loading, 43-ton, new *282
Gunboats, Epsilon, for China *197
Gunboats, new, for Chinese Governm't *69
Gunboats, steam, British, new *128
Gun camera, the *389
Gun-carriage, naval, Vavasseur's *294
Gun-carriages, artillery, Russian 41
Gun-carriages, Moncrieff, full particulars of construction *5
Gun-cotton, manufacture of at the Stowmarket Works 320
Gun-cotton, uses of in war 165
Gun, eighty-ton, trial of *78
Gun experiments, the Thunderer *216
Gun, fortress, Russian, at the Centennial 31
Gun, field, steel, French *137
Gun, Gorgon *203
Gun, hundred-ton, Italian *230
Gun, life-line, Evans and Low's *332
Gun, machine, Gardner *340
Gun, masked, or Panzerkanone, Krupp's *59
Gun metal, strength of, experiments on at Portsmouth dockyard 100
Gun, mountain, Armstrong *159
Gun, multicharge, Lyman-Haskell, and experiments in firing it *416
Gun, multiple charge, Lyman-Haskell *397
Gun, new 100-ton, trial of in the Royal Arsenal, Woolwich *256
Gun, Nordenfelt, on H.M.S. Monarch *268
Gun, one-hundred-ton, trial of at Woolwich. 252
Gunpowder, chemical theory of, by Prof. Debus 372
Gunpowder gas, apparatus to measure pressure of *269
Gunpowder, lampblack, Cahuc's 142
Gunpowder, manufacture at the factory of Col. Paul A. Oliver, at Laurel Run, Pa 333
Gunpowder tester *269
Gun, revolving, Hotchkiss' *47
Gunshot, velocity of 254
Gun tests, Hotchkiss 237
Gun, 13-pounder breech-loading, English. *257
Gun, 38-ton, remarkable target-practice with *59
Gun, time, electrical, at Pernambuco *21
Gun, Uchatius' 82
Gun, 13-pounder, a new *214
Gun, 20-ton, Whitworth, test trials of a 405
Gun, 80-ton, recent trials of against armor. *66
Gun, 81-ton, details of construction and results of trials with *48
Gun, 81-ton, experimental firing at Woolwich. 4
Gun, 100-ton, Armstrong's *39
Gun, 100-ton, at Spezia, Italy, experimental firing of at iron plate targets *62
Gun, 100-ton, breech-loading, interesting account of the trial of at Spezia, Italy *374
Gun, 100-ton, Italian mode of casting 203
Gun and embrasure, mechanism, Gruson's. *408
Guns, Armstrong, 43-ton breech-loading *297
Guns, bores of, action of gunpowder in, by Capt. C. Jones, R.A 16
Guns, breech-loading mechanism for, Johnson's. *124

Guns, cast steel; experiments with the new artillery made from steel without blows, by M. Gautier 97
Guns, field, Bange's *426
Guns, heavy, horse power of 34
Guns, heavy, Krupp's improved *167
Guns, Hotchkiss, for torpedo boats *428
Guns, heavy, new mode of rifling 25
Guns, monster, loading of in modern ironclads, by Capt. A. Albini *172
Guns, Nordenfelt, in action *409
Guns of the future, a discussion on at Woolwich 224
Guns of the Inflexible, trials of 270
Guns, test of the value of by firing under water, by H. A. Mott, Jr *127
Gutta percha and India rubber, by Thomas Bolas, F.C.S *249, *251, 252
Gutta percha, durability of 236
Gutta percha in telegraphy, by W. H. Preece. 246
Gutta percha, trees producing 409
Gymnastics, mechanical, Zander's *213
Gypsum, different varieties of and their characteristics 395
Gyrograph, Nicolas', for drawing arcs of circles of large radius *285
Gyroscope, magneto-electric *233

H

Hackles, combs, and gills *187
Hail and snow, colored, by A. T. Machattie 76
Hail, formation of, by M. Faye 2
Hailstones, extraordinary *55
Hailstones, raindrops, and snowflakes, how formed. Abstract of a paper by Prof. O. Reynolds *65, *118
Hailstorms and their accompanying phenomena, study of 173
Hailstorms, remarkable, in France, by L. Godefroy *302
Hair dye, bismuthic, by A. Naquet 356
Hair dyes in common use, analyses of 239
Hair, hygiene of. Abstract of a lecture by Prof. Erasmus Wilson 102
Hair, its use and its care. A paper by Dr. J. V. Shoemaker, briefly describing the functions of the hair, and suggesting the proper manner of preserving it in a healthy state 388
Hair restorers, metallic, their composition, mode of application, and chemical action 396
Hair, superfluous, removal of by electricity, by G. H. Fox, M.D 176, 353
Halley, Edmund. His life and work 224
Hammer, atmospheric, Butterfield's *44
Hammer, power, atmospheric, Chenot's. *353
Hammer, power, Bradley's *47
Hammer, power, electric, Deprez's *352
Hammer, power, Hasse's *214
Hammer, steam, double spring, Belleter and Klunz's *19
Hammer, steam, Ferris and Miles' *40
Hammer, steam, for bossing locomotive wheels. *320
Hammer, steam, improved *265
Hammer, steam, largest in the world 140
Hammer, steam, 10-ton, Massey's *428
Hammer, steam, 80-ton, at the St. Chamond forging mill *303
Hammers and stamps, forge, Longworth's. *86
Hammers, lift, driving gear mechanism for, Meier's *365
Hammers, power, with movable fulcrum, by Daniel Longworth *344
Hammers, steam and pneumat. Thwaites'. *396
Hammock, elastic suspension, D'Amora. *106
Hand-car, Roman's *173
Hand stamps, rubber, how to make 83
Handkerchief extracts, a choice collection of formulæ for, by R. H. Cowdrey 281
Handwriting, characteristics of 429
Hangers, shafting, and couplings *205
Hank dyeing, washing, or sizing machine. *111
Hank sizing and wringing machine, impr. *360
Harbor at Boulogne, new *151
Harbor, Newhaven, Eng. extension of *161
Harbor works, proposed, for Greenock 118
Harbors and estuaries on sandy coasts, by L. F. Vernon-Harcourt 341
Harkness, Prof., the geologist. Brief sketch of, with portrait *156
Harmonic analyzer, Sir Wm. Thomson's. *272
Harp, designed by Prof. W. Wollanek *101
Harrison, John, the chronometer maker. Biographical sketch of, by Samuel Smiles 379
Harrow, flexible, Howard's *59
Harrow for macadamized roads *381
Harvesting machinery. A critical examination of some of the mowing machines which are in practical use at the present time, by E. Samuelson 291, 292
Harvey, William, statue of, at Folkestone. *300
Harvey, William, the discoverer of the circulation of the blood. With portrait and an illustration of an event in his life *168
Harvey, William, the remains of, by Benj. W. Richardson, M.D *160
Hats, felt, how made, and what diseases the workmen suffer from, by L. Dennis, M.D 191
Hats, straw, recipes for bleach'g and dyeing. 277
Hauling engine underground, Fowler's. *156
Hawaiian Islands, volcanic phenomena of 382
Hawsers, steel-wire vs. hemp 36
Hawsers, steel and hemp 302
Hay as food for hogs 200
Hay compressor, Albaret's *123
Hay fever 195
Hay fever and asthma. A lecture by Prof. Alonzo Clark, M.D 221
Hay Fever Association, report of committee on scientific facts 242
Hay fever, remedy for 81
Hay, green, value of 53
Haymaking, valuable suggestions upon 83
Hay-press, Pilter's *371
Hay-ricking apparatus, Hill's *8
Headache, congestive, the treatment of, by Dr. J. L. Corning 415
Headache, remedy for 240
Headache, sick. A valuable study of the conditions, symptoms, and treatment of sick headaches, by Dr. T. C. Smith 337
Headache, sick, cause of, by Dr. Savage 357
Headache, sick, remedy for 363
Headache, various remedies for, by eminent physicians 383
Headaches from eye-strain, by Dr. S. Weir Mitchell 32
Headaches, how to treat, by Dr. F. A. Simmons. 258
Health and sewage of towns, practical experience with the dry system, by Dr. Alfred Carpenter 80
Health and skill, how to promote, by Dr. W. St. George Elliott 100
Health, good, how to secure, by Dr. T. L. Nichols 117
Health, laws of, importance of a knowledge of, by Thomas Bond, F.R.C.S 32
Health, public. An address before the British Sanitary Congress, by Douglas Galton 359
Heart disease, organic, treatment of, by Dr. William Pepper 172
Heart, palpitation of, remedy for 56
Heat, Arctic, of former times, causes of 174
Heat and light; an interesting paper, by Robert Ward 259
Heat conduction, in highly rarefied air, by Wm. Crookes 270
Heat developed in forging, experiments on. *415
Heat, mechanical, equivalent of, electro-magneto determination of, by Marcel Deprez *356
Heat from friction, machine to obtain *271
Heat, light, and electricity, are they expressions of the same force, by Prof. Elihu Gray. A valuable and interesting paper 379
Heat in muscular action 97
Heat in relation to chemical action. An account of some of the results that have been obtained by experimenters in thermo-chemistry, by Henry Allen 291
Heat, mechanical equivalent of, apparatus for illustrating, Puley's *13
Heat, prickly, how to cure 50
Heat, radiant, action of an intermittent beam of, upon gaseous matter, by Prof. John Tyndall. 272
Heat, solar and sidereal, origin of, by Prof. Daniel Kirkwood 127
Heat, solar, apparat. to measure, Ericsson's. *70
Heat, solar, printing by *357
Heat, specific, how determined in liquids and solids; how determined in gases; difference between the phenomena presented by the specific heat of gases and of liquids and solids. 264
Heater and purifier, feed-water, Strong's. *363
Heater and purifier, feedwater, Fromentin's *346
Heater, feed-water, improved, Atkinson's. *141
Heater or thermo-siphon, Gallet's *297
Heater, water, Millar and Durie's *257
Heaters and gas burners, Defty's *362
Heaters and stoves for hot air and water ... *213
Heath, Irish, white *378
Heating agents, gas and electricity as, by Dr. C. W. Siemens 278
Heating and lighting, co-operative 284
Heating apparatus, care of 251
Heating by gas, apparatus for, Gomez's. *417
Heating by hot water. A valuable paper by a hot water engineer, with directions as to the proper piping and arrangement *171
Heating cars, French system of *177
Heavens, the dislocation of, by Camille Flammarion *5
Hedge cutting machine, new *186
Heights and distances, inaccessible, methods of measuring, by T. E. Candler *313
Helichrysum rosmarinifolium *413
Heliograph, or sun signal, improved, by Tempest Anderson, M.D *253
Heliograph, pocket, Macgregor's Ekowe. *258
Heliograph, improved, Stone's *287
Heliostatic star-disks, phenomena developed by G. W. Royston-Pigott *310
Heliotelegraph, Lesueurre's *284
Heliotrope, how to make for geodetic surveying *163
Heliotype printing plates, how to make 205
Hell Gate, progr. of mining operations at 266
Heloderma horridum, or Gila monster ... *388
Hemiplegia from cerebral hemorrhage. A clinical lecture, by Prof. Austin Flint, M.D 130
Hemorrhage, accidental, simple methods of staunching, by Edward Borck, M.D. A valuable paper *299
Hemorrhage, remedy for 18
Hemorrhoids, cure for 417
Hemorrhoids, treatment of by injection 190
Hemp, jute, etc., tests for 90
Hemp, new use for 218
Henley, W. T. Biographical sketch of 371
Hen ranch, a Maine 395
Henry, Joseph, by A. M. Mayer. An interesting account of Prof. Henry's life and labors, giving the story of his great discoveries in electrical science and of his other researches, and presenting many anecdotes illustrative of his character 247
Henna leaves and powder, by Dr. Heinrich Paschkis *289
Hens, how to feed for eggs 166
Hens, laying, rules for the management of, by Dr. A. M. Dickie 230
Herald Island, the newly discovered 312
Herbs, pressed, how to preserve, by J. U. Lloyd. 26
Hermes of Praxiteles, restoration of *394
Herring, by Prof. Huxley 285
Hevecnold, by Henry A. Mott, Jr. Description of a new product destined to supplant soft and hard vulcanized rubber 233
Hibernation of animals 372
Hide, animal, microscopical and chemical examination of and its behavior with water, by Carl Sadler *356
Hides, green, how to preserve 208
Hides, green, preparation of 273
Hides, trade in 253
High-grinding, Austro-Hungarian *137
Highland House, Cincinnati *120
High School, new, Oxford *286
Hill, Sir Rowland, the eminent social and administrative reformer. Biographical sketch and portrait *198
Hip-joint disease, by Dr. L. A. Sayre 122
Histology and the cellular theory, by Dr. Edward Fournie. A valuable paper, presenting an interesting history of the cellular theory of tissue-structure 137, 140, 142, 144
History, unwritten, and how to read it, by Prof. John Evans. A valuable paper 369
Hive bee, origin of the cells of 419
Hoarseness, recipe for 81
Hog-cholera, or pneumo-enteritis, its nature and treatment 228
Hoist, electric, Hopkinson's *318
Hoist, hydraulic, for docks, Mavillier's. *107
Hoist, hydraulic, Tangye's *286
Hoisting apparatus, Pyott's *12
Hoisting engine, Williamson Bros.' *35
Hoisting machinery for vessels, by H. W. Pendred *234
Hoisting, pneumatic system of 146
Hoisting ropes, loads and strains on, interesting facts concerning, by W. S. Hall 396
Holloway, Thomas, biographical sketch of and portrait *424
Homestead, for fifty cows, prize design. *289
Homœopathic law, the range of in the practice of medicine, by Dr. W. H. A. Scott 97
Honey extractor, centrifugal, Emmons'. *46
Honey wasps and their nests *239
Hoof-cushions, rubber; figures of the two kinds of India-rubber hoof-cushions that have come into use, and of the device employed for fastening them into the horse's shoe *178
Hooke, Robert. An account of his life and labors, by C. S. Murray 400
Hooks, safety, Booth and Sugden's *252
Hop analysis, principles of, by G. O. Cech. 303
Hop-culture in New York, by E. G. Bissell. 105
Hop-resin, its nature and properties 220
Hops, chemistry of 373
Hops, on the repeated boiling of, by Dr. Schneider 419
Hornbeams (Carpinus), the species of *421
Hornets and wasps *382
Horns, fog, and sirens 341
Horograph, a new electric pen *183
Horograph for schools, Matthey's *373
Horse and his fossil ancestry 353
Horse-breaking by electricity *208
Horse, cart, show at London, with large illustration of prize animals *328
Horse-clipping, a defense of 311
Horse dentistry 88
Horse detacher, Ehret's *29
Horse disease, new 92
Horse, good, points of. Report of the committee appointed by the New England Agricultural Society to decide upon rules for guidance of judges of horses. An excellent guide in selecting animals 103
Horse, how to tell the age of 217
Horse medicine bit *404
Horse, motions of, scientifically considered, with 22 figures showing the several positions of body and limb assumed by the horse in walking and trotting, from instantaneous photographs. *158
Horse, Percheron 246
Horse, perfect, and how to measure him; description of the celebrated Kentucky Prince, with table of measures, and an illustrative diagram showing the application of the system to any horse *29
Horse, proportions and conformations of. An engraving showing the skeleton and outline of a perfect horse, along with name of part, proportions, and familiar terms *225
Horse, race, Blair Athol *355
Horse, race, Iroquois, first American winner of the Derby *290
Horse, race, Martini Henry *424
Horse, race, Sir Bevys *185
Horse, race, St. Blaise *392
Horse, race, Verneuil, win'r of Ascot Cup. *136
Horse, Sefton, winner of the Derby *134
Horse stables, floors for 308
Horse, the American, by E. L. Berthoud 311
Horse, trotting, American, evolution of the, by Prof. William H. Brewer 386
Horse, trotting, Bend Or *239
Horse, trotting, Don Cossack *273
Horse, trotting, Luke Blackburn *269
Horses and cattle, carrots as a food for 45
Horses, calculus in, how to treat 53
Horses, care of, hints on 419
Horses, cart, exhibition of, London *277
Horses, corns in, how to prevent 253
Horses, educated, American, in London, with full page illustration, showing training *386
Horses, farm, practical directions for feeding and keeping 2
Horses' legs, how to treat 224
Horses' legs, by R. H. Hilhouse. An article of great interest to all horse owners, showing by means of diagrams the correct pose and the faults so frequently met with in combination in one and the same horse *195
Horses, mash for, recipe 53
Horse's motion, science of *346
Horses, polydactyl, and recent and extinct. A valuable and interesting paper by Prof. Marsh, showing how the present species of horse has been evolved from many-toed ancestors. *188
Horses, portable food for 98
Horses, race, records of the fastest. Table of the best time on record at all distances and all ways of going to Jan. 1, 1883 374
Horses, the care of 123, 185
Horses, trotting, celebrated, record of, from 1838 to 1883 377
Horse-power and thrasher, Hofherr's *49
Horse-power, coal per hour 284
Horse-power, home made, for farm use. *190
Horse-power of a steam engine, how to estimate 253
Horse-power, locomotive versus 140
Horse-shoeing. A paper of great interest to horse owners, giving numerous valuable hints as to the care of the animal's feet and the proper way to have them shod 404
Horse-shoeing, by D. E. Salmon, D.V.M. 174
Horse-shoeing, principles of, by Dr. George Fleming, V.S 205
Horse-shoeing, the art of, its history and principles, by Prof. M. Keil 378
Horseshoes, improved, Thistlewood's *15
Horticultural Hall, Centennial Exhibition *3
Horticultural items: Cultivation of orchards; washing the bark; apples for export; transplanting; yellows of the peach; California raisins; apples in Massachusetts; hand weeding 329
Horticultural notes: New apples, pears, grapes, etc; discussion on grapes: new peaches; insects affecting horticulture; insect destroyers. ... 275
Horticultural notes: New grapes; garden use of fertilizers; lime dust; low-headed trees; liquid grafting wax 70
Horticultural notes; Packing grapes; thinning fruit; setting raspberries in autumn; raising seedling strawberries; watermelons and muskmelons; easy mode of striking cuttings, etc. 46
Horticultural notes; Planting strawberries; hot beds; pears in Missouri; protection of fruit trees against rabbits; apple orchards of Ohio. 63
Horticultural notes: Velocity of sap; cultivating orchards; laying down grapes; early peaches; Snyder blackberry; killing wasps; worms in flower pots; unfermented wine 101
Horticulture, electrical, by Dr. Siemens. 304
Horticulture, humbugs in, by P. Henderson 238
Hospital and private practice in San Francisco, by H. Gibbons, Jr. Notes on the treatment of consumption, cough, night sweats, intermittents, typhoid fever, malarial diseases, rheumatism, neuralgia, heart diseases, and jaundice 193
Hospital of St. Eloi, at Montpellier, France, by Frederic J. Monat, M.D *307
Hospital for insane, State, Pennsylvania ... 289
Hospital, German, new, in San Francisco. *359
Hospital, Philadelphia, practice and peculiarities of treatment at, notes on 184
Hospital, St. Francis', New York; notes of practice and peculiarities of treatment in, by Dr. G. M. Edebohls 56
Hospitals, disinfection, apparatus for *262
Hot air drying apparatus, Redfern's *64
Hot air engine, Rider's *49
Hot air engine, the Sachensenberg *162
Hot air engine, Todt's *284
Hot air engine, Van Renne's *247
Hot air engines vs. gas and steam 368
Hot air stoves and hot-water chimneys. *213
Hotbed frames, how to make *271
Hotbeds, how to make 323
Hot-blast, mode of operation in iron furnaces, by J. L. Bell 29
Hot-blast process, Neilson's 278
Hot-blast stove, Weimer's *45
Hotel de Ville, Paris, and its great clock. *347
Hotel of the Patrons of Industry at the Centennial *30
Hot pressing, apparatus for *224
Hot water as a plant restorer 128
Hot water chimneys *213
Hot water, therapeutical drinking of, its origin and use, by E. Cutter, M.D., with full directions for using the remedy, and an enumeration of the diseases in which it is useful 406
Hot water treatment, clinical notes on 117
Hot-water heating apparatus 325
House at Farnham, Eng *289
House at Holly Park *325
House at Nottingham Park, Kent *410
House building on a sand-hill, by J. J. De Kinder *297
House drainage, abstract of a lecture by Edward S. Philbrick *242, *243
House drainage, by James R. Willett *32
House drainage, sewerage, and ventilation, by R. Middleton 272
House for the country costing $600 to $700, designs and plans for *340
House, half-timbered, English *137
House of Parliament, Vienna *428
House of the fifteenth century, France. *369
House, old, Hereford *390
House, $2,500, plans and specifications for. *394
Household ornaments, by G. M. Hopkins. Directions for the easy manufacture of a great variety of beautiful objects for the adornment of the parlor and home, of wood, but finished in imitation of bronze ware, including vases, urns, medallions, card receivers, brackets, match safes, picture frames, etc *7
House-fly, development of, by M. B. Robson. *202
House plants, how to cultivate 6
House trimmings, ornamental *68
Houses at Leicester *317
Houses, cheap, several designs for *387
Houses, country, cheap, design for. *340, *359, *387, *394
Houses, dwelling, hints on building, by W. Henman 384
Houses, dwelling, sanitary appliances for, by F. Botting *369
Houses, English *242
Houses, English, memorable: Newton's, Fixman's, Canning's, and Johnson's *312
Houses, glass, construction of 424
Houses, healthy, rules for securing, by Robert Rawlinson, C.E 348
Houses, quaint, at Bristol, Eng *159
Houses, vegetable, plans for 66
Hudson's Bay, exploration of. The results of five years' work by the Canada Geological Survey 298
Human life, the phenomena of, by John Tyndall. A valuable paper 97
Human personality, what is the meaning of? By Henry J. Slack, F.G.S 51
Human race, age of, by Prof. B. F. Mudge. 195
Hunting by electric light *361
Huxley, Thomas H. Biographical sketch, with portrait *400
Hyacinth bulbs, by Grant Allen 322
Hydrant, injector, fire extinction, by J. F. Greathead 425
Hydrants, how to get large streams from. *256
Hydraulic accumulator *230
Hydraulic and other cements, by Q. A. Gillmore, U.S.A 64
Hydraulic brake, Barker's *78
Hydraulic canal lift on the Weaver, England, by Sidengham Duer, R.Sc., C.E 19
Hydraulic capstan and windlass, Tweddel's, *217

Hydraulic cement, white, recipe....211
Hydraulic cements, notes on....64
Hydraulic cotton press, compound....*114
Hydraulic crane, 160-ton, Armstrong's....*20
Hydraulic dredging machine, Newton's, *100
Hydraulic dumping....153
Hydraulic elevator for canals....*334
Hydraulic elevators and motors, by B. F. Jones. 392
Hydraulic engineering, construction of sea walls in....*209
Hydraulic experiments, recent, having for object the finding of a good mode of discharge measurements for large canals and the testing of existing formulas....365
Hydraulic experiments with large apertures at Holyoke, Mass., by Gen. T. G. Ellis....18
Hydraulics, experiment in....*353
Hydraulic filter-press for treating oleaginous seeds....*358
Hydraulic flanging and straightening machine....*300
Hydraulic hoist, improved, Mavillier's....*107
Hydraulic hoist, Tangye's....*286
Hydraulic joint cut-off, Jarre's....*332
Hydraulic lime, artificial, manufacture of near Paris....311
Hydraulic machine tools, by R. H. Tweddell....382
Hydraulic mach. tools for ship-building....*266
Hydraulic machinery. A valuable paper, by Prof. Perry, treating of the theory of water-wheels, turbines, water-pressure engines, presses, hoists, pumps, etc....*366, *373
Hydraulic machinery, St. Gothard Tunnel. *7
Hydraulic machinery for operating the lock gates of the Des Moines Rapids Canal, by R. R. Jones....*280
Hydraulic machinery of the Royal Aquarium, London....*14
Hydraulic mining in California, full details of, by A. J. Bowie, M.E....*106
Hydraulic mining at Dutch Flat....48
Hydraulic organs, ancient, by A. De Rochas. *354
Hydraulic pile driving....*237
Hydraulic press, Brinck and Hubner's....*387
Hydraulic press for iron plate....*417
Hydraulic press, Perry's....*366
Hydraulic propulsion, a new system of, by Vice-Admiral J. H. Selwyn....354
Hydraulic punching and shearing machine, Chapman's....*75
Hydraulic ram, Montgolfier....*155
Hydraulic rams, the earliest and the latest forms explained, by C. L. Hett....*111
Hydraulic rams, useful information concerning....15
Hydraulic riveter for ships' keels....*266
Hydraulic riveting machines, Tweddell's. *140
Hydraulic shears, Tweddell's....*22
Hydraulic steamboat, new, Maginot and Pinette's....*415
Hydraulic steering gear, Lafargue's....*142
Hydraulic telegraph, Montbianc and Gaulard's....*334
Hydraulic transmission of power....68
Hydraulic tunneling machine, Crampton's. *379
Hydrocarbon engine, Brayton's....*58
Hydrocarbons, gaseous, heat of combustion. 258
Hydro-dynamic experiments, Bjerknes'. *355
Hydro-dynamometer, Pellat's....*399
Hydro-extractors, French, improved....*175
Hydrogen and oxygen, liquefaction of, by Raoul Pictet....128
Hydrogen gas, apparatus for manufacturing, Giffard's....*153
Hydrogen gas, apparatus for manufacturing on a large scale, Tissandier's....*413
Hydrogen gas, new process and apparatus, Tessié du Motay's....*241
Hydrogen, peroxide of, as a deodorant and disinfectant....166
Hydrogen, peroxide of, its preparation and uses, by George E. Davis....184
Hydrogen, peroxide of, its use for medicinal and bleaching purposes, by Dr. P. Ebell....339
Hydrogen, solidification of, by R. Pictet....128
Hydrogen sulphide from coal gas, by Prof. I. Taylor....*384
Hydrogen, sulphureted, appar., Kähler's. *258
Hydrogen, sulphureted, apparatus for making small quantities of, by Peter Hart....287
Hydrogen, sulphureted, new method of preparing....203
Hydrometer scale, Baume's, by J. Tagliabue. 429
Hydromotor, Fleischer's, a new steam vessel propelled by water jets....*308
Hydrophobia, a case of, by C. C. Pike, M.D. 125
Hydrophobia, a case of, and recovery, by Jas. Nicholls, M.D. One of the most valuable contributions that the literature of hydrophobia has received....137
Hydrophobia, a successful treatment of....128
Hydrophobia, currare and other cures for. 230
Hydrophobia, injections of the virus of into the circulation do not cause rabies, and seem to confer immunity therefrom, by V. Galtier. 352
Hydrophobia, specific for, by Dr. Grzyvala. 63
Hydrophobia, treatment of by oxygen....87
Hydrophobia, virus of, experiments with. 276
Hydrostatic balance, Wackermann's....*224
Hygiene, a lecture by R. Southey, M.D.....157
Hygiene in the higher education of women, by A. H. Bennett, M.D. A valuable paper....215
Hygiene, school, by Dr. D. F. Lincoln.....10
Hygrometer for mills....*334
Hygrometer, new, Klinkerfues'....*14
Hygrometer, registering, Richard's....*379
Hygrometer, rustic....*155
Hylozoic materialism, by R. Lewins, M.D. 291
Hypnotism, by George J. Romanes....148
Hypnotism in Paris....371
Hypnotism, the phenomena of. A very interesting paper by Drs. Bourneville and Regnard, describing the various methods of inducing hypnotic sleep or a cataleptic state in human subjects....*295
Hypochondriasis, by Dr. A. L. Loomis....174
Hysteria, grave, treatment of by metalloscopy, by Prof. Charcot....123
Hysterical somnambulism and catalepsy, induced, by Prof. Charcot....256

I

Ice age, evidences of, by H. Woodward....*76
Ice, anchor, how formed....288
Ice and iron, analogies between the properties of, by T. Wrightson....237
Ice and water, properties, by J. Y. Buchanan. 406
Ice, artificial, for skating....21
Ice, artificial production of at the Manchester Ice-making Co.'s works....*91
Icebergs and glaciers, a new study of....342
Icebergs, formation of. Abstract of a paper by Lieut. Schwatka....260
Ice boat sailing faster than the wind, graphic demonstration of....*54, *61
Ice boats, their construction and management, with working drawings, details, and directions in full. Four engravings, showing mode of construction, by H. A. Horsfall....*1
Ice breaking vessel, Swedish....387
Ice cavern of Dobschau....*195
Ice, how to preserve at the bedside....38
Ice, hot. A note on the existence of ice and other bodies in the solid state at temperatures far above their ordinary melting points, by Prof. Thos. Carnelley....271
Ice, hot, a repetition of Carnelley's experiments, with variations, by J. B. Hannay....*289
Ice house and cold rooms. Description of an ice house suitable for farm use, with elevation, sections, and plan....*59
Ice house, cheap, how to construct....*55
Ice houses and refrigerators, how to construct, by John Taylor....*116
Ice houses, cheap, how to construct....*99
Ice machine, chlor. methyl, Vincent's....*358
Ice machine, domestic, Toselli's....*32
Ice machine, Linde....*171
Ice machines, production of cold in....238
Ice machines worked by compressed air (see Air).
Ice making and machines, by W. N. Hartley. 85
Ice making machine, Sideley and Mackay's. *73
Ice making machinery at the skating rink, London....*35
Ice, medicated, by Dr. J. V. Mott....73
Ice, physical properties of, by Dr. Jno. Rae. 171
Ice-skating in summer; the Glaciarum, London, with illustrations of the ice making machinery employed....*35
Ice, the age of, by H. B. Norton....*200
Ice under low pressures, by S. Young....*381
Ice under low pressures, experiments on, by Thomas Carnelley....*290
Ice, regelation of, experiment on....*243
Ice yachts fast. Full description and complete working drawings of ice boats of the latest and best construction....*63
Ice yacht Icicle....*61
Ice yachts, speed of....*214, *220
Ice yacht Whiff....*63
Ice yacht, why it sails faster than the wind. *61
Ichthyol, dermato-therapeutic uses of....384
Igneous rocks, an address before the British Association, 1880, by H. C. Sorby. An important geological paper....255
Ilang-Ilang oil, by F. A. Fluckiger....288
Illinois, glacial period in....400
Illuminating agents, solid and liquid, by L. Field, treating of the composition of fatty bodies, and processes for separating them to obtain palmitic, stearic, and oleic acids....*403
Illusion, optical, curious....*285
Illusion, optical, curious, by R. A. Proctor. 194
Image, reversal of on gelat.-bromide plates. 267
Implements of the stone age, how made....198
Inclined plane at Briancon....*410
Inclined planes of the Morris Canal, N. J. History of the canal, construction, service, operation of planes, expense, etc., by H. M. Wilson. *373
Inclined planes, Cincinnati....120
Inclination and declination, magnetic; apparatus to determine, Stroumbo's....*160
Incubation, artificial....*54
Incubator, electric....*425
Incubator, new....*380
Incubator for the stage, microscopic, new. *68
Index plates for gear cutting, how made. *317
India and Ceylon, Prof. Haeckel in....348
India rubber and gutta percha industries. A series of six lectures by Thomas Bolas, F.C.S. A very comprehensive, interesting, and instructive paper....*249, *251, 252
India rubber, how gathered in Colombia....318
India rubber, new sources of....391
India rubber, Para and Ceara, and balsam of copaiba trees....144
India rubber plants....325
India rubber trees, cultivation of in India. 279
India rubber, trees that yield....318, 325
Indian skin-scrapers, by Dr. C. C. Abbott. *14
Indian stone tubes and tobacco pipes, by C. C. Abbott....*33
Indian tribes of the Hudson's Bay Co.'s territories....346, 347, 348
Indicator, automatic, for signaling passage of trains, Ducousso's....*380
Indicator, bilge-water, for ships, impr'd. *112
Indicator cards taken at St. Louis water works, by A. J. Chaphe....*123
Indicator, speed, Darke's....*228
Indicator, electric, for steam boilers....*173
Indicator for water channels....*96
Indicator, pistonless, Kenyon's....*233
Indicator, speed, Deprez's....*356
Indicator, speed, for trains, Westinghouse. *64
Indicator, speed, Harding and Willis'....*107
Indicator, speed, Moss'....*6
Indicator, speed, Normanville's....*96
Indicator, speed, Napier's....*215
Indicator, speed, Theiler's....*92
Indicator, speed, Wiers....*6
Indicator, stability, for ships....*385
Indicator, strain, Stromeyer's....*257
Indicator, tidal, registering....*3
Indicators for alkalimetry, by E. J. Hallock. 325
Indicators for noxious gases, Coquillon's. *102
Indicators, tidal and river-water, self-registering....*3
Indigo, artificial preparation, history of, by Carl Schorlemmer....266
Indigo, method of fixing on printed fabrics. 82
Indigo, method of recovering from spent vats, by G. H. Underwood....25
Indigo sulph. preparat'n of, by M. Van Laer. 173
Induction balance and sonometer, by Geo. M. Hopkins; details of construction, accompanied with figures, of a new and convenient form of Hughes' apparatus, which may be used to distinguish between metals and alloys by a method hitherto unknown....*196
Induction balance Hughes, experiments. *289
Induction balance, Hughes'....*184
Induction coil, a few experiments with. A paper by Geo. M. Hopkins, describing a number of interesting experiments with the induction coil, which exhibit phenomena peculiar to the secondary current....*166
Induction coil, how to make; full and plain directions for constructing the apparatus, accompanied with a complete set of working drawings, by Geo. M. Hopkins....*160
Induction coil, large, Spottiswoode's....*229
Induction coil, regulator for, Floyd's....*152
Induction coil, Spottiswoode's....*74
Induction coils and electro-magnets, improvements in, by T. Trowbridge....23
Induction, experiment on....*225
Induction in telephone lines, by J. W. Urquhart, C.E....*251
Induction machine, Voss'....*291
Induction, phenom. of, by Prof. E. J. Houston. 6
Induction, phenomena of....*347
Induction spark, heat phenomena of....373
Induction, volta electric, by W. Smith....*417
Industrial art for women, carpet design'g. .315
Industrial chemistry, progress of, by J. W. Mallet. 186, 188, 204, 214, 221, 232, 237, 261, 277, 287
Industrial education, new feature in. .*230
Industrial science, recent progress of, abstract of address by E. A. Cowper....299
Inebriety, a medical study of obscure cases, by T. D. Crothers, M.D....368
Inebriety, chloral, by Dr. J. B. Mattison....212
Inebriety, tobacco, by Dr. A. B. Arnold....294
Inertia, experiments on....*243, *247
Inertia, an illustration of....*426
Infant, biographical sketch of, by Chas. Darwin. An interesting account of the progress of mental development in one of the author's children. .86
Infant, development of mind in....257
Infant, health in the, conditions of. A valuable paper, by W. B. Atkinson, M.D., upon a subject on which the books are nearly silent....163
Infernal machine, Thompson's....*10
Inhalation, vapors for, in sore throat....271
Initials, ornamental....*259
Injection apparatus, constant pressure, new form of, by William Libbey, Jr....*353
Injection pump, automatic, Laurent and Collot's....*358
Injector for corros. liquids, Hemptinne's. *327
Injector, Friedmann's....*42
Injector, Giffard, exper. on the theory of. *212
Injector, Hall's....*153
Injector hydrant for fire extinction, by J. H. Greathead....425
Injector, improved, Hart's....*112
Injector, locomotive, Körting's....*57
Injectors, feed-water; descriptions and illustrations of various systems in use based on the Giffard apparatus....*356
Ink and paper, fireproof....158
Ink for copying without a press, how made. 304
Ink, indelible, for rubber stamp, how made. 23
Ink, indelible, formula for....185
Ink, invisible, recipe for....389
Ink printing, direct, from glass negatives, process for, by H. Brand....131
Ink, printing, how to make indelible....21
Ink, purple, for marking linen, recipe for.... 17
Ink stains, how to remove....55
Ink, stamping, indelible, recipe for....373
Ink, writing, black, recipe for....267
Ink, writing, non-corrosive, recipe for....209
Inker, telegraph, Devo's....*117
Inks, aniline, several formulas for....230
Inks, copying, aniline black, and powder and tablet, preparation of....45
Inks, lithographic, machine for grinding, Alauzet's....*388
Inks, method of detecting, by W. Thomson, F.R.S.E....255
Inks, various recipes for: Writing, indelible, copying, marking, sympathetic, drawing, stencil, gold, silver, indestructible, shoemaker's, etc. 157
Inks, writing, aniline, how to make....89
Inorganic compounds, molecular properties of, and their action upon the living animal organism, by Dr. James Blake....289
Insane Asylum, State, New Jersey....*110
Insane Asylum, State, Pennsylvania, new....289
Insane, care of, by H. Wardner, M.D....321
Insane, care of, report of New York State Committee of Investigation....346
Insane, the rights of, by C. H. Hughes, M.D. 386
Insane, treatment of at Gheel, by Dr. W. J. Morton....271
Insanity from alcohol, by Dr. A. Baer....415
Insanity in the U. States, by T. J. Hutton. .122
Insanity, philosophy of, by Dr. John Sanderson Christison....308
Insect, a strange; the basket carrier, or house-building caterpillar, by William H. Gibson. *138
Insect destroyer of wheat, new....*337
Insect destroyers of books....*138
Insect killer, Pyrethrum the best....247
Insect pests, to protect trees and vines from. 298
Insect pests in libraries....201
Insect powder, experiments with....179
Insecticides....254
Insecticides, by Dr. H. Behr....308
Insecticides, two valuable, London purple and Pyrethrum powder....218
Insects and flowers, mutual relations of....298
Insects and how to fight them....232
Insects and other small objects, how to electrotype....64
Insects, exotic, curious....*196
Insects, destruction of by moulds....203
Insects injurious to vegetation, notes on....363
Insects, injurious, how to exterminate, by Andrew Murray....82
Insects, noxious, how to destroy....165
Insects, scale, by Prof. Comstock. A paper of great value to horticulturists, giving the natural history of these pests, and showing how they may be exterminated....261
Insects, simple directions for collecting, preserving, and packing, by Frederick Le Roy Sargent. *333
Insects under glass, how to destroy....354
Insects, vitality of in noxious gases....373
Insensibility from deficiency of oxygen in the air, by William Wallace, Ph.D....386
Instruments, scientific, delicate, by Edgar L. Larkin....288
Insulator, improved, Crighton's....*222
Insulators, telegraph, improved....*102
Integrating machine, Boys'....*288
Integrator, the Amsler-Laffon....*247
Integrator, totalizing, Abakanowicz's....*369
Intellect, influence of age on....246
Intensification for wet plate negatives of line engravings, easy method of....409
Intensifier for wet plates....388
Intensifiers, mercury, by C. I. Burton and Arthur P. Laurie....319
Intensifier, new, for line work....47
Intermittent fever, pilocarpin in, by Gaspar Griswold, M.D....201
Inula glandulosa....*361
Invalids, how to feed....250
Invention, ethics of, by an old technologist. 318
Inventions of the century. Abstract of a lecture by Prof. Pliny E. Chase....70
Inventions of women at the Centennial....34
Iodide and bromide emulsion, new way to prepare....339
Iodine in cod liver oil, by M. Mitchell Bird. .325
Iodine and bromine, apparat. to separate ...*228
Iodine and bromine, manufacture of from kelp, by Robert Galloway, F.C.S....149
Iodine, bromine, nitrate of potash, and soda, manufacture of from kelp, by T. Schmidt...116
Iodine, extraction of from seaweeds....246
Iodine, preparation, tests, combinations, etc., by C. Ehrmann....431
Iodoform for diphtheria....373
Iridio-platinum, manufacture of, by G. Matthey....183
Iridium and platinum, purification of....194
Iron, addition of tungsten to, for obtaining steel of great hardness, and of moderate hardness combined with high ductile capacity, by R. Akerman....18
Iron, amalgam, how to clean....79
Iron and coal in Alabama....285
Iron and coal in Brit. Columbia....120
Iron and concrete as a building material....122
Iron, anti-corrosion paint for, recipe....415
Iron and its constituents in regard to pharmaceutic preparations, by H. G. Debrunner....102
Iron and other metals, overstrain in; a new method of detecting, and its application in the investigation of the causes of accidents to bridges and other constructions, by R. H. Thurston....*138
Iron and steel analysis, filtra. of carbon in. *216
Iron and steel. A paper by Edward Williams on the present status of the iron making industry and on the production of steel in bulk by the newer processes for railway requirements, ship building, and other constructive works....181
Iron and steel, application of wolfram in the manufacture of....152
Iron and steel as constructive materials, progress of, by J. A. Picton, F.S.A....203
Iron and steel at the Centennial Ex..27, 30, 31
Iron and steel, by Dr. C. W. Siemens. An interesting and valuable paper, containing accounts of the most recent practical improvements in the production, working, and application of these two metals....70, 71
Iron and steel by Knowles' process....4
Iron and steel, carbon in, determination of, by A. S. McCreath....69
Iron and steel, carbon in, new method of determining, by N. B. Wood....*411
Iron and steel castings, how to prevent honeycombs in....116
Iron and steel corrosion, Mr. Bessemer's experiments on....125
Iron and steel, direct process, Bull's....*380
Iron and steel, direct process for, by Jacob Reese....55
Iron and steel *en masse,* estimation of the total carbon in, by Sydney C. Jutsum....*220
Iron and steel, evident magnetism in, cause of, by Prof. D. E. Hughes....390, *392
Iron and steel from the ore, a new process of making, by W. A. Lyttle....*24
Iron and steel, how to blue....115
Iron and steel manufacture, by W. Mattieu Williams. An interesting account of the process of converting iron into steel by the Bessemer process....*43
Iron and steel manufacture, improvem'ts in. 77
Iron and steel plates, the effect of punching on, by A. C. Kirk....*95
Iron and steel, preservation of, by Barff and Bower processes, with plans and elevations of furnaces and description of operation....*287
Iron and steel, progress and improvements in the manufacture of, and the future of the industry, by Bernard Samuelson, M.P....388
Iron and steel, properties of, by Daniel Adamson, C.E. A valuable record of experiments to prove the tensile strength of these metals, both in the shape of bar and plates....*150
Iron and steel, sulphur in, estimation of....*362
Iron and steel, tests for....29
Iron and steel under the Hay process, by A. T. Hay....282
Iron and steel works, American, by A. L. Holley and Lenox Smith....75
Iron and steel, wrought, the direct process of making, by C. M. Du Puy, C.E....157
Iron as a building material. A comprehensive review, giving the objections to the architectural use of iron, and its advantages; how to treat iron artistically; cast and wrought iron under fire; valuable suggestions how to use iron in fire-proof structures....71
Iron as a natural constituent of wines, by C. R. Alder Wright....86
Iron, bar, mill for dressing and rounding....*362
Iron bars, straight and round, planishing of by the Butler process....45
Iron, cast, furnace for refining....*248
Iron, cast, in architecture....324
Iron, cast, porosity of....216
Iron, cast, thin, process of tinning....92
Iron castings, malleable, meth. of making. 399
Iron castings, shrinkage strains in, by Alfred E. Watkins....34
Ironclad ships (see Ships and Steamers).
Iron, coal required to puddle a ton of....76
Iron, coating to protect from rust....393
Iron Company, Bethlehem, works of, by A. L. Holley and L. Smith....*93
Iron, corrosion of, by Wm. Foster, M.A....228
Iron, corrugated, rolling-mill for making. *286
Iron, deposition of copper on, in a magnetic field, by Ira Remsen....293
Iron direct from the blast furnace in the Bessemer process, discussion on at the Iron and Steel Institute....21
Iron, effect of magnetism in toughening....256
Iron, effects of crystallization upon, by N. B. Wood, C.E....344
Iron electrotypes, solution for....92
Iron embedded in brick work, expansion of. 347
Iron, finely divided, conduct of toward nitrogen, by Ira Remsen....292
Iron, floating, atmospheric....98
Iron, foreign constituents of, methods of estimating....393
Iron forging, heat developed in, experiments on....*415
Iron forging, manual, substitution of the Haswell squeezing process for....45
Iron fronts for buildings, and their decoration, by J. P. Putnam....100
Iron, galvanizing, zinc bath for....*161
Iron hills of Cornwall, Pa....7
Iron, how to bronze....95, 235
Iron, how to case harden....23
Iron, how to coat with copper....213
Iron, how to galvanize. A valuable paper. 176
Iron, how to inlay pearl on....224
Iron, ingot, and soft steel, Harvey process.. 94
Iron, inoxidation of, and coating metals and other surfaces with platinum by the processes of Mr. Dode, by L. M. Stoffel....177
Iron, linseed oil as a protection for, by Mr. Wm. Foster, M.A....223
Iron, magnetic, a hill of in Mexico....313
Iron, magnetic, polarity in, by Jos. Wood...426
Iron making direct from the ore, Bromfield's process....*364
Iron making, natural gas in....72
Iron, metals which accompany it in its ores, by A. Terreil....81
Iron, meteoric, of Santa Catarina, by Stanislas Meunier....*148
Iron, method of assaying, by Bruno Kerl. A valuable technical paper....*16, *22
Iron, microscopical examination of, notes on. A paper by A. Martens, demonstrating the practicability of determining the comparative value of different kinds of iron by microscopic examination....*165, *168, *172, *174
Iron, molten, magnetization of....*192
Iron, new process for, Beil's....33
Iron, new process for, by Wm. Batty....*21
Iron, new method of coating with magnetic oxide, by G. R. Tweedie....183
Iron ore, crystalline, origin of, by Dr. J. S. Newberry....378
Iron ores, different qualities of, by J. Reese. 278
Iron ores, reduction of; various methods that have been proposed for manufacturing wrought iron by the direct process....9
Iron oxides, new mode of treating....84
Iron oxide, spent, treatment of to obtain Prussian blue....79
Iron, pig, production of in the U. States....127
Iron pipe, under pressure, proper thickness. 192
Iron pipes, large, manufacture of....*419
Iron plates, hydraulic press for....*417
Iron plate rolling-mill, Jepson's....*6
Iron plates, circular, machine for beveling, Pedder and Abel's....*45
Iron, porcelain enamel for, how to make....314
Iron, preserving, Barff process....*213
Iron, protection of by linseed oil, by W. Foster. 223
Iron puddling, furnace for, Bicheroux's*344
Iron, punching, experiments in....68
Iron pyrites, formation and decomposition of, by Prof. F. Sandberger....341
Iron railway ties, and sleepers, by Charles Wood....125
Iron, removal from wheat by magnets....*175
Iron rolls, chilled, manufacture of....34
Iron roof, 42-ft. span....*237
Iron rust, prevention of....392
Iron salt for electrolytic depositing of steel on copper....207
Iron, sheet, Russian, how made....154
Iron, sheet, Russian, manufacture of, by H. B. Froom....301
Iron sponge, recent improvements in the manufacture of by the Blair process, by J. Ireland....125
Iron, spongy and putrescent organic matter, by Gustav Bischof....*87
Iron structures, preser., by C. G. Smith.. 91
Iron surfaces, preservation of, Barff's hot steam process, Bower's hot air process....126
Iron, the influence of magnetism on the tenacity of, by Prof. Emilio Piazzoli....*221
Iron, ton of, fuel used to smelt....83
Iron, treatment of to prevent corrosion, Barff process....174, 175
Iron tubes, welded, improved process of manufacture....119
Iron, varnishes for protecting....226
Ironware, hollow, how enameled....248
Iron welding. A paper by R. Howson, describing the improved system of iron welding employed at Low Moor....47
Iron wire, zinc bath for galvanizing....*34
Iron-working machine, universal....*337
Iron, wrought, crystallization of, examples by Joshua Rose....6
Ironing machine, new, Ruhemann and Jacobi's. *192
Ironwork, notes on, by G. Smith....214
Irrigation in California, by J. L. Dow....418
Irrigation in Northeastern Colorado, by P. O'Meara, Inst.C.E....387
Islands about New York city....268
Islands of the South Pacific....236
Israelites, where did they cross the Red Sea? By A. W. Thayer....223
Ivory and gold, sculpture in....182
Ivory and its modern uses....148
Ivory, artificial, recipe for....66, 159
Ivory, sources of, by Consul C. B. Webster. 376
Ivory, the supply of and whence derived, by P. L. Simmonds....359

J

Jaborandi, fluid extract of 93
Jack-screws for raising rails *265
Jacket, steam, spiral, new *25
Jacquard, Marie Joseph, by Hugh McCall. An interesting account of the life and labors of the inventor of the loom that bears his name 254
Japan, art manufactures of, by C. Dresser 115
Japan and China, scientific progress in 392
Japanese, the height and span of 224
Japanning, full details of the process, with recipes for primings and japans 316
Jardin d'Acclimatation of Paris 239
Jardiniere in silver, design for *156
Java, earth movements in, by R. Proctor 416
Javelle water, how to make 314
Jaw, lower, protrusion of and treatment, by Dr. Geo. S. Allan *168
Jeannette Expedition the last of 427
Jelly, gelatine, as a dialyzer 335
Jellies, a new adulteration of *232
Jellies, jams, and preserves. A valuable collection of household recipes 196
Jersey cattle *30
Jerusalem, discovery of ancient church in 415
Jerusalem, temple of, as rebuilt by Herod the Great *148
Jet for a wash-bottle, Bunsen's *99
Jet mining and working 41
Jetties, South Pass, Mississippi *200, *201
Jetty works at the mouth of the Mississippi River. A history of the work, with precise details of the construction, dimensions, method, etc., by E. D. Cortell, C.E., Chief Assistant Engineer of the works, with 11 illustrations, including large chart of the South Pass and the lines of the jetties *21, *28
Jetty works of Galveston harbor *16
Jevons, W. Stanley. Biographical sketch 356
Jewelry, Italian, and French, modern, designs for *104
Joan of Arc, statue of by Leroux *256
Joint, screw, differential, for coupling pipes, Bourry's *80
Joint, track and rail, standard *395
Joints, dovetail, tests of the strength of, by C. P. Gilbert *33
Joints on gas and water mains, a novel method of forming; a lead joint calked by hydrostatic pressure *109
Joints, pipe, elastic, Roche's *25
Joints, plumbers', how to make. A valuable practical paper *309, *311
Joints, riveted, for steam boilers, by G. Cawley. *96
Joints, water and steam, how to make. By J. Rose. A valuable practical paper 41, 43
Joule, James Prescott, chemist and electrician. Biographical sketch of, by J. T. Bottomley. With portrait *363
Journal box, self-oiling, for car axles, shafting, saw mandrels, etc., Tomlinson's *118
Judges, American and foreign, of the Centennial Exhibition 30
Juniper, blue, weeping *386
Jupiter, by Prof. G. W. Hough *247
Jupiter, observations of 357
Jupiter, periodical spots on, by Amédée Guillemin *223
Jupiter, the giant of the worlds, by Camille Flammarion *196
Jupiter, the mass of, by H. A. Smith 402
Jupiter, the red spot on *302
Jute and tow carding engine *106
Jute and flax cards, how made *145
Jute, hemp, and other fibers, methods of distinguishing between 90
Jute, how to bleach 249
Jute, its cultivation, characteristics, etc. 137
Jute, manufacture of, by William Fleming; origin of the industry, preparation of the material, description of the machinery, and mode of manufacture 247
Jute, various dyes for 260
Jute yarn, how to bleach 221

K

Kairene, the new substitute for quinine 406
Kaleidoscope, new, McIlvenna's; description of a greatly improved form of the apparatus, with cuts showing details of construction. *197
Kaloula, an Indian batrachian *260
Kangaroo, habits of 388
Kansas, gas and coal wells of, by Dr. J. Thome. 207
Kastner, Frederick, inventor of the pyrophone, biographical sketch of 357
Keir, bleaching, Bracewell's *205
Keir, boiling, for yarns, new *341
Keir explosions, by W. Nanson *128
Keirs, boiling and bleaching, how constructed and used 106
Kentucky, the wonderful caves of 88
Kerite, composition of 183
Kew Observatory, by W. H. Harrison 390
Keys and keyways, how to fit, by J. Rose 56
Keyways, how to cut out, by Joshua Rose. A valuable practical paper *79
Kidney extirpation, a case of, by Dr. J. Marion Sims 185
Kiln, brick, railway, Foster's *186
Kiln, continuous, for burning bricks, tiles, pipes, lime, etc., Lancaster *148
Kiln, gas, Thompson's 314
Kiln, lime, for farmers, how to construct *360
Kilns, brick, Dueberg's *148
Kilns, brick, continuous, Lancaster's 148
Kilns for charcoal manufacture *415
Kilns for manufacturing charcoal *422
Kircher, Father, cabinet of, by L. Rochas *427
Kitchen, steam, Egrot's *352
Kleptomania, temporary, by Hugh Miller, M.D. 140
Knapsack, desk, for army use, Bergeret's *369
Kneading and mixing mach., Pfleiderer's *215
Knitting machine, Lane and Timaeus' *400
Knitting machine for Cardigan jackets, Gimson and Coltman's *28
Knives, forks, and scissors, ornamental *77
Knocking devices for doors, old *401
Knocking in high pressure engines, causes of, by Joshua Rose *1
Knots and splices. An exhaustive paper on splicing, tying, and fastening ropes for ship's rigging, for lifting tackle, and many other purposes; illustrated by ninety-four engravings, showing knots, splices, hitches, slings, etc., so clearly as to enable any one to make them easily without reference to the text *319
Knowledge, natural, the limits of, by Professor C. Von Nägeli 110
Knowledge, physiological, by Prof. Huxley 88
Knowledge, the six gateways of. Abstract of an interesting lecture by Sir W. Thomson 413
Knurling and chasing, tools for *313
Kola nut, a remedy for drunkenness 369
Koumiss, its mode of preparation and remedial value, by William Pepper, M.D. 130
Krakatoa, eruption of *429

L

Labels for plants, how to make 279
Labels, tablets, or advertising sheets, machine for making *265
Labor, mechanical, of one man 249
Labor, relation to education, by J. Johonnot. 97
Laboratory experiences on board the Challenger, by J. Y. Buchanan 119
Laboratory manipulations, simple; use of felt pads in protecting glass vessels; examin. of crystals by the microscope, by Dr. P. T. Austen 92
Laboratory, pharmaceutical, small, equipment and working of, by G. F. Schacht *99
Laboratory tools, apparatus for coating *258
Laboratory, zoological, sea-side, Naples *280
Lac, the production and commerce of, by P. L. Simmonds 238
Lace, thread, American, method of making *34
Lacquer, Japanese, an analysis of 173
Lacquer, Japanese, its manufacture and applications. A full and interesting account of the method of lacquering various objects, as practiced by the Japanese; illustrations of the tools employed, etc. *43
Lacquer work, gold. A very interesting account of the process as practiced by the Japanese. 355
Lactic acid, manufacture of, by C. E. Avery. 340
Lactometer, Soxhlet's *292
Lactometers and lactodensimeters *71
Ladder, garden, portable, how to make *219
Lager beer, how to make 217
Lake basin, Tertiary, new, in the Rocky Mountain region, by Robert B. Grinnell and Edward S. Dana 15
Lake, pitch, of Trinidad, by W. O. Crosby 174, 175
Lake Tahoe, physical studies of, by Prof. John Le Conte 294, 295
Lakes, alkaline and boracic, of California, by J. A. Phillips 79
Lakes, distribution of in the United States, by Prof. John Le Conte 232
Lamp, Bunsen, theory of, by Prof. Thorpe 67
Lamp, drop, Taylor's *86
Lamp, electric, for miners, Plante's *414
Lamp, electric, Reynier's *208
Lamp, electric (see Electric lamp).
Lamp, gas, Clamond's *351
Lamp, magnesium, Loiseau's *375
Lamp, safety, Olding's *149
Lamp, tar oil *258
Lamps, Argand 361
Lamps, brass, how to clean and brighten 114
Lamps, perpetual, of antiquity *409
Lamp-pendant, silver, ornamental *45
Lamp-post, ornamental, design for *44
Land, arable, how formed *28
Landscapes, artistic, how to take 400
Lantern, dissolving, Newtonian, impr'd *104
Lantern for exhibiting sound waves *254
Lantern, magic, Kircher's *427
Lantern, magic (see Magic lantern).
Lantern slide, new, Thomson's *104
Lantern transparencies, gelatine, how to make 288
Lantern transparencies, how to color 423
Lantern transparencies, how to make 173
Lantern transparencies, how to prepare 424
Lapiace, cosmogony of, by D. Kirkwood 210
Laplanders, habits and utensils of *162
Lard, preparation of for use in pharmacy, by Prof. Redwood 415
Laryngoscopic examinations, how made. *108
Larynx, extirpation of, by D. Foulis, M.D. *115
Lassell, William, the astronomer. An account of his life and researches, by Wm. Huggins. 264
Lathe, automatic, Heyne's *406
Lathe, compound, and oval eccentr. chuck *89
Lathe for making spokes, Robinson's *420
Lathe for turning piston rods, Schönheyder's. *22
Lathe, gap, for screw-cutting, Thuillier's. *375
Lathe, spinning, Bliss and Williams' *35
Lathe, tire-grinding, Simmering's *181
Lathe, universal, impr., Koch and Muller's. *10
Lathe, useful, how to make at slight cost. *311
Lathe-tools for clockmakers *87
Lathes and planers, cutting tools for, by Joshua Rose. A valuable paper *38
Lathes, foot, for use on ships *421
Lathes, slide, combined self-acting, Shaw, Hossack & Co.'s *37
Latitude of a place, how to find by the stars. 316
Launch, Herreshoff, experiments with 259
Launch, steam, Cinderella. Description of a small speedy screw propeller launch which can be easily run by one man; with figures of plan and elevation *90
Launch, steam, steel, new *99
Launch, steam, paper 391
Launch, steam, Russian *75
Launch, steam, small *224
Launch, steam, sectional, for exploring purposes *239
Launch, steam, Stella, U. States *416
Launch, torpedo, Herreshoff *169
Launching the ironclads Kaiser and Deutschland, and other large ships, by D. A. Samuda. *97
Lauraceæ, homologies in, by L. F. Ward. *194
Laurel water. artificial, by A. Ripping 101
Law Courts, English, new *368
Law, farm (see Farm law).
Law of Avogadro and Ampere 280, 286
Law, patent, German, new, text of 80
Law, physical, thoughts on our conception of, by F. E. Nipher 168
Law, railroad, progress in New York 231
Laws, natural, harmony and application of, by B. T. Giraud 351
Laws, State, concerning sale of patents, void. 25
Lawn, alders for the, by S. Parsons, Jr 236
Lawn, grasses for 266
Lawn, how to make 271
Lawns, advice on plowing 154
Lawns, how to manage 126
Lawns, lime on for killing worms 290
Lawns, two good trees for; how to sod 275
Lawn-making, hints on 271
Lawn tennis, rules of, with plans of courts for single, three, and four handed game *301
Lead, a new method of purifying 92
Lead and copper, action of sea water upon, by Wm. H. Watson 79
Lead and its alloys, estimation of 147
Lead, curious facts about 366
Lead, determination of from its ore by electrolysis, by Ad. Sommer, Ph.G. *389
Lead, detection of in potable water by means of potassium bichromate, by Sidney Harvey 300
Lead, desilverization of by the zinc process, by J. E. Stoddart 268
Lead, elimination of in saturnine paralysis 81
Lead fume, and a new process of fume condensing, by A. French 202
Lead, how to coat articles with 265
Lead pencil manufacture, history of 157
Lead pipe aqueduct, cheap 266
Lead pipe, machinery for making, Weems'. *413
Lead pipes and lead contamination, notes on, by Wm. Thomson 334
Lead poisoning. A clinical lecture by Dr. Wm. Pepper 235
Lead processes, some recent improvements in, by Norman C. Cookson 299
Lead, properties and uses of 429
Lead, removal of from the human system by electricity 53
Lead, sounding, Lecentre's *239
Lead, white, what its composition should be to form a serviceable paint, by G. W. Wigold and R. H. Harland 75
Leather, artificial, new 9, 54
Leather, artificial, from leather parings and caoutchouc 44
Leather, constituent parts of 286
Leather cork, novel, how made 18
Leather, destruction by gas, by G. E. Davis. 109
Leather dyeing colors and shades applicable to, by E. N. Beller 405
Leather, harness and upper, method of stuffing and working *368
Leather, imitation, recipe for making 169
Leather, lace, how to tan with soft soap 331
Leather, manufacture of 331
Leather, method of dyeing with aniline colors, by W. Eitner 72
Leather, russet. Report on the manufacture of russet leather and its adaptability for the military service, by Capt. D. A. Lyle 335
Leather, tanned and tawed, varieties of and their uses, by W. H. Van Benthuysen 356
Leaves and grasses, skeleton, how to prepare. 270
Leaves, autumn, how to preserve 313
Leaves, etc., how to take copies of 64
Leaves, functions of, chemical examination of, by Wm. Coveninder *28
Leaves, how to take impressions of 25
Leaves, the power they possess of placing themselves at right angles to incident light. Abstract of a paper by Charles Darwin 271
Le Duc, Viollet, biographical sketch of, with portrait *202
Leg, fractures of, new apparatus for, by Dr. O. J. Croskerey *55
Lemming, Norwegian, and its migrations, by W. Duppa Crotch *75
Lemmings, the ways of, by Dr. G. A. Stockwell. 403
Lens, enlarging, photographic, new, by J. H. Dallmeyer *236
Lenses, achromatism of, cause of and remedy for *409
Lenses and plates, how to clean 97, 141
Lenses, camera, improved, Steinheil's *47
Lenses, focus of, quick way to ascertain *385
Lenses, how made *139
Lenses, how to make *318
Lenses, instrument for measuring *62
Lenses, photographic, manufacture and characteristics of, by J. T. Taylor 415
Lenses, photographic, new, Voigtlander's. *116
Lenses, spectacle, new system of numbering. 127
Leprosy in America 171
Lesseps, de, Ferdinand, biographical sketch, with portrait of himself and family *270
Letter-copying process, Adler's 224
Lettuce-growing, structure of greenhouses for 304
Leveling apparatus, new, Aita's *87
Leveling land, Lowe's process for *12
Levels, hand, new, Abney's and Bohne's *133
Leverrier, Jean Joseph, biographical sketch, with engraving of bust by Préault *181
Lexington (Cal.) oil belt, development of 205
Leyden jar, a simple *271
Leyden jar, Rood's apparatus to determine nature and duration of its discharge *168
Leyden jar, apparatus for obtaining long sparks from *105
Liberty and restraint 406
Libraries, insect pests in, by Dr. H. Hagen. 201
Library building, a librarian's notion of what it should be, by W. F. Poole 272
Library, design for *108
Library of Firmin-Didot, sale of, and prices realized for rare books 139
Library of Congress 254
Lichens, synthesis of *126
Lichtdruck with water colors 103
Liebig, Biograph. sketch of, with portrait. *374
Life, ancient, in America. Address by Prof. O. C. Marsh before the American Association, 1877. An interesting review of mammalian life in America from its first known appearance in the trias down to the present time 90, 91
Life and matter, studies of, by H. J. Slack 27
Life at timber line, by Prof. C. E. Robins 169
Life-boat canoe, Evangelist *112
Life-boat, Chapman's *6
Life-boat, double, with sea-dividing ends, Jackson's *99
Life-boat, improved, Stockwell's *29
Life-boat, impr'd, Timnis and Hodgson's. *361
Life-buoy, new, Whitby's *294
Life, individual, from an evolutionary point of view, by G. Glaser 253
Life-line gun, Evans and Low's *332
Life, lowest forms of, by Prof. Huxley 175
Life on the earth, progress of, by Miss A. B. Buckley 373
Life preservers for cavalry use, Zuboritz's *73
Life-raft, Rider's *34
Life-saving rafts *198
Life-saving service of the United States; its organization, apparatus, personnel, station houses, etc. *37
Life, the beginnings of, by Prof. Edmond Perrier. An interesting series of papers, describing the simplest forms of life that exist in nature, and examining the question whether the physical forces, acting upon oxygen, hydrogen, and nitrogen, are capable of uniting these elements in such a way as to form living beings comparable with chemical compounds, as respects origin. *188, *189, *190, *191, *202, *203, *204
Life, the natural duration of, by B. W. Richardson, M.D. 211
Life, the problem of, address by Prof. G. F. Barker before Amer. Assoc. Adv. Sci. 246
Lifting-tackle *319
Light, a new standard of, by L. Schwendler. 225
Light, a review of the doctrine of ether waves and the material nature of light, by Ellen R. Prescott 375, 376, 377
Light, a phosphorescent tablet as a standard of, by A. Spiller 374
Light, aberration of, apparatus for illustrating, by Prof. T. W. Tobin *230
Light, absorption of in the atmosphere 338
Light, action of upon coloring matters 264
Light and electricity, relation between, by Dr. O. J. Lodge 275
Light and heat, by Robert Ward 259
Light and sound, analogy by Prof. Barrett 40
Light, chemical action of, by Dr. J. M. Eder. 339
Light, chemistry of; a lecture by John Edmond Fairlie, F.R.C.S. 222
Light, drop, improved, Taylor's *86
Light, electric (see Electric light).
Light, electro-motive changes produced by, by Prof. Dewar 28
Light, gas, waste of, causes and remedies 125
Light, heat, and electricity, are they expressions of the same force? By Prof. Elihu Gray 379
Light, lime, by T. F. Hardwich 281
Light, obstruction of by glass 272
Light, oxygen, production of *419
Light, oxyhydrogen, value of as compared with that from coal gas 6
Light, oxyhydrogen, zirconia for 93
Light, physiological action of, by Prof. Jas. Dewar *73
Light, polarized, color in *117
Light, polarized, application of to the examination of the alkaloids of the quinia group, by H. A. Mott, Jr 129
Light, recent wonders of; an interesting lecture, by W. H. Preece 225
Light-shafts, elevator, and twin staircase, by S. Gray *28
Light-ship, Seven Stones, at Land's End. *262
Light, stored up 244
Light, sun, electric, and magnesium, relative chemical energy of, by Prof. A. R. Leeds. *176
Light, the action of, with special reference to dyestuffs, by D. Dawson 269
Light tower, electric, San Jose *350
Light, velocity, apparatus to determine, Wheatstone's *165
Light, velocity, experimental determination of, by Alb. A. Michelson, U.S.N. *193
Light, velocity of, new measurement by Prof. Newton 246
Light, violet, for studios 67
Light, white and colored, velocity, experimental determination of, by Dr. J. Young and Prof. G. Forbes 292
Light, zodiacal, by Prof. C. W. Pritchett. *126
Light, zodiacal *241
Lights, actinism of, how to determine its relations to the same illuminating power, by Leon Vidal 302
Lights, Bengal, how to prepare 49
Lighters, electric *367
Lighters, electric, Maigret's and Ranque's. *289
Lighters, electric, Ranque's and Loiseau's. *362
Lighthouse, Chipiona, Cadiz *170
Lighthouse, cleaning reflectors in *429
Lighthouse, Eddystone *157
Lighthouse, Eddystone, new *190, *419
Lighthouse illumination, improvements in, by J. R. Wigham *147
Lighthouse, Lavezzi *169
Lighthouse, Little Basses, lantern of *60
Lighthouse of Ar-men, Finisterre *272
Lighthouse, Minot's Ledge *190
Lighthouse, proposed, at the mouth of the Weser River *380
Lighthouse, Rothe Sand, at the mouth of the Weser *342
Lighthouse-signals, gas for 330
Lighthouse, the Dhu Heartach, by David Allan Stevenson, B.Sc 24
Lighthouses and accessories at the Centen. 30
Lighthouses, illumination of, by Dr. Stevenson Macadam 258
Lighthouses, Norwegian 215
Lighting and heating, co-operative 284
Lighting appar., incandesc., Schloesser's. *427
Lighting arrangement of the Vanderbilt mansion *331
Lighting by electricity, by Robert Briggs 98
Lighting by electricity, machines used for 99
Lightning, action on telephone apparatus. 301
Lightning conductors, Faulkner's plan of applying 226
Lightning conductors, by R. Anderson 249
Lightning conductors, proper forms of, by Wm. Henry Preece. A valuable paper 249
Lightning conductors, the space protected by. A paper by W. H. Preece, in which the author shows by the aid of diagrams the amount of space that will be protected by a lightning rod of any given dimensions *288
Lightning conductors, experiments on 237
Lightning flashes, instantaneous photographs of *425
Lightning, globular and chaplet, new investigations of, by Gaston Planté *61
Lightning, Indian ideas concerning 207
Lightning; look out for it. Hints to telegraph operators 339
Lightning, mechanical action of 341
Lightning, protection of buildings from, by Capt. J. T. Bucknill. A valuable paper *348
Lightning protector, telegraph, Vaes' *29
Lightning protector, telegraphic, new *1
Lightning protectors for telegraphic apparatus, by Wm. Henry Preece 198
Lightning-rods, instrument for testing, Bucknill's *296
Lightning, some early experiments with. *66
Lightship, new, Pintsch system *325
Lignification, chemistry of, by C. F. Cross and E. J. Bevan 377
Lignite, burning of *in situ*, by C. A. White. 395
Lily, calla, culture of 173
Lily, white, of the Incas: Eschscholtzias: Masdevallia carderi *403
Lime, action of on silica in water 210
Lime and its uses 428
Lime cartridges for blasting, how made 416
Lime, chloride, the Weldon process for 206
Lime, hydraulic, artificial, manufacture of near Paris 311
Lime instead of powder for mining *403
Limed coal, manufacture of gas from, by J. A. Franklyn 431
Lime-juice, its properties and uses, by Michael Conroy, F.C.S. 375
Lime-kiln for farmers *360
Lime-light, by T. F. Hardwich 281
Lime-light without oxygen 72
Limestones, soft, how to harden 406
Line shafting, how to adjust, by J. Rose. *190
Line, straight, how to draw, by A. B. Kempe. *84, *85, *86, *87
Linen chest, in oak, design for *424
Linen, purple tint for marking, recipe 17
Lines for ships, Jackson's *78, *96, *102
Lingo of miners, definitions of 181
Linseed oil and electrified oxygen 241
Linseed oil as a protection for iron. A paper by Mr. William Foster, M.A. 223
Linseed, varieties of in English commerce, by E. M. Holmes, F.C.S. *306
Lioness and cubs *305
Lip salves, recipes for 216
Liquid fuel as used in Russia *403
Liquid manure for grapes; marketing fruit; the root apis; yellows in the peach; smoking orchards unsuccessful; preventing pear blight; setting out blackberries; plants in rooms; fruit trade at Baltimore; watering plants and trees; roses for garden culture 263
Liquid measure, Monroy's *378
Liquid meter, Helbing's *371
Liquid surfaces, vibrations of, experiments on, by Mr. Barthelemy *28
Liquids, gases, and solids, by W. Mattieu Williams 329, 330
Liquids in drops, forms of, by A. M. Worthington *86
Liquids, speci. gravity, how to determine. *216
Liquids, viscosity of, apparat. to determine. *271
Liquors, distilled, apparatus to age *12
Liszt, Franz, sketch of, and portrait *312
Lithium, atomic weight of, and the characteristics of its salts 373
Lithographic stone, the supply of, whence derived 81
Lithographic process, photo, Butter's 227
Lithography, photo, by T. Bolas 143
Lithography, photo, how to practice 247
Lithography, photo, rapid 284
Liver-fluke, life history of the *390
Living matter, recent researches into its nature and phenomena, by Prof. G. J. Allman, M.D., F.R.S. A valuable paper 195, 196
Lock-gate, canal, hydraul. machinery for. *280
Lockjaw, remedy for 31
Locks, American vs. English 108
Locomotion, human, mechanical aids to 126
Locomotive air reservoirs *197
Locomotive and tender brake, Hickey's. *101
Locomotive, Baldwin, for the Dom Pedro Railway, Brazil *42
Locomotive boiler, firebrick fire-box for *172
Locomotive, central-power, Raub's *304
Locomotive, compressed air, Beaumont's. *263
Locomotive, compressed air, Beaumont's, experiments with 61
Locomotive, compressed air, Beaumont's, for steel railways *317
Locomotive, compressed air, built for St. Gothard Tunnel *1, *2
Locomotive, compressed air, improved. *309
Locomotive, compressed air, for mines, Mekarski's *428
Locomotive connecting and parallel or coupling rods, by Joshua Rose 331
Locomotive, consolidation, Baldwin *252
Locomotive crane, Black, Hawthorn, and Co.'s *54
Locomotive crossheads, Borsig's *82
Locomotive cylinders, apparatus to bore. *281
Locomotive driving-wheels, contact of on the rails, by Zerah Colburn *26
Locomotive, Eddy's *97
Locomotive, electric light, Marshall's *179
Locomotive, electro-magnet., Davidson's. *359
Locomotive engine driving, practical notes on, by Michael Reynolds 206
Locomotive engine, electric, how to make, by G. F. Chutter *19
Locomotive engines, improvements in the construction of 27
Locomotive, English, Fairlie's double-bogie, 3 ft. 6 in. gauge, for New Zealand *5
Locomotive exhaust-chamber, new, Pollock and Wilkinson's *141
Locomotive, express, French *152
Locomotive, express passenger, for London and South Eastern R.R. *7
Locomotive, express, 6-coupled, English. *145
Locomotive, Baldwin, for N. J. Cent. R.R. *38
Locomotive, 15-inch gauge, Haywood's. *296
Locomotive fire-box, Kaselowsky's *59
Locomotive fire-box, Pennsylvania R.R. *21
Locomotive, fireless, Lamm's 140
Locomotive, fireless, tramway, Francq's. *329
Locomotive, first, the Stourbridge Lion 90
Locomotive for burning liquid fuel *403
Locomotive, Fontaine; a discussion as to its merits and the principle involved in its construction *311

Locomotive for rack railway near Vienna..*70
Locomotive for street railways, Porter, Bell, and Co.'s..*73
Locomotive for underground hauling, Fowler's..*156
Locomotive, freight, eight-coupled, Paris and Orleans R.R..*148
Locomotive injector, Körting's..*57
Locomotive, how much will it pull?..184
Locomotive lamp, electric, Sedlaczek..*334
Locomotive, links in the history of..*292
Locomotive, Lion, built in 1829..*33
Locomotive, narrow gauge, Fairlie..*102
Locomotive, narrow gauge, new, for Indian States railways..*53
Locomotive, novel use of for coal hauling from mine..367
Locomotive of 1835, Gillingham Winans'..*36
Locomotive, oscillating cylinder, Shaw's..*324
Locomotive painting, by John S. Atwater. A valuable paper..358
Locomotive, Paris and Orleans R.R..*131
Locomotive, passenger, Austrian..*230
Locomotive, passenger, Baldwin..*331
Locomotive, passenger, detailed cost of..322
Locomotive, passenger, fast, built by the Baldwin works for Bound Brook line..*231
Locomotive, passenger, Glasgow and South-Western R.R..*410
Locomotive, passenger, new, London, Brighton, and South Coast R.R..*407
Locomotive, passenger service, Fontaine, by John Orton..*305
Locomotive, passenger, Western Railway of France..*135
Locomotive performances, notable..413
Locomotive, powerful, El Gobernador..*425
Locomotive, rack and pinion, for narrow gauge, Hagans'..*409
Locomotive reaping machine, Aveling and Porter's..*36
Locomotive, road and agricultural, Wallis and Steevens'..*93
Locomotive, road, for the Engl. Channel..*48
Locomotive, road, improved..*303
Locomotive, road, new, Marshall's..*56, *71
Locomotive, road, eight h. p., Armitage and Ruston's..*49
Locomotive shunting..*256
Locomotive, six-coupled, on the Lancashire and Yorkshire R. R..*269
Locomotive, six-coupled tank, Cail..*215
Locomotive, special type, for the Western Railway of France..*6
Locomotive, tank, Dutch Rhenish R..*304
Locomotive, tank, for narrow gauges, Swedish..*41
Locomotive, tank, for the Billerica and Bedford two-foot gauge railroad..*115
Locomotive, tank, improved..*368
Locomotive, tank, Swiss..*132
Locomotive, tank, 16-ton, Schneider's..*166
Locomotive, traction, for common roads, Robey's..*6
Locomotive, tramway, Brown's..*131
Locomotive, tramway, compressed air..*248
Locomotive, twin, with freight platform between..*171
Locomotive vs. horse power..140
Locomotive; what to do when it breaks down. A valuable practical paper, by F. C. Smith, giving plain directions for the management of the locomotive in accidents of various kinds..314
Locomotive wheels, hammer for bossing..*320
Locomotive, 16-wheel, and tender, improved..*397
Locomotive, 12-wheeled, for the Lehigh Valley Railroad..*347
Locomotives, advance in the price of..314
Locomotives, American, in Australia..93
Locomotives, American vs. English..61
Locomotives and cars of the N. Y., West Shore, and Buffalo R.R..411
Locomotives and railroads, early American. Historical sketch by Frank C. Smith..*371
Locomotives at the Centennial Exhibition; tabular statement of leading particulars regarding details of construction, with 18 outline figures of the various types shown..*35
Locomotives, axle-cranks of, apparatus for squaring and measuring..*284
Locomotives, big; weight and dimensions of the heaviest freight and passenger engines in use in this country..341
Locomotives, bogie system of..*215
Locomotives, compressed air, for tramways, by Sir F. J. Bramwell..*357
Locomotives, consolidation and American, Baldwin..*24
Locomotives, English and American..370
Locomotives, express, passenger, Great Western Railway, London..*58
Locomotives for ascending steep grades, Cottran's..*363
Locomotives for burning petroleum, Urquhart's..*63
Locomotives for the St. Gothard Railw..*384
Locomotives for 18-inch gauge at Crewe works, England..*44
Locomotives, fireless, for tramways, by G. Lentz..*361
Locomotives, fireless, Francq's..*174
Locomotives, loads hauled by..327
Locomotives, machines for repairing..*281
Locomotives, new method of supplying with water, Howe's..*21
Locomotives of the St. Gothard Railway, by R. Abt..351
Locomotives, passenger, fast..252, 301
Locomotives, passenger, Midland Railway, Eng., with particulars of dimensions, consumption of coal, and performance..*27
Locomotives, railway, Chinese..*37
Locomotives, recent improvements in..297
Locomotives, smoke-preventer for, Reimberr's..*61
Locomotives, standard, parallel-rod for, of the Lake Shore and Michigan Southern R..*295
Locomotives, Stephenson, the first..*290
Locomotives, tank, of the London, Chatham, and Dover Railway, Eng.; full particulars of dimensions and mode of construction..*23
Locomotives, tests of on Boston and Albany Railroad for performance and consumption of fuel..45
Locomotives, traction of, rule for calcul'g..287
Locomotives, tramway, Brown's..*222
Locusts as food for man, by D. A. Lyle..397
Lode, Comstock, by A. P. Schack..*73
Lode, Comstock, by J. S. Hittell..*29
Lodge, etc., proposed, on recreation grounds, Sydenham..*114
Lodges and cottages, designs for..*9
Lodges, English..*404
Log indicator for ships, De Normanville's..*96
Logwood. A lecture by Prof. George Jarmain, showing the nature and extensive uses of this valuable dyeing material, methods of preparation, chemical conditions of its coloring principles, the various colors it is capable of producing, together with the latest and best recipes for the practical use of the dye..54
Logwood, apparatus for extracting..*389
London, earliest map of..410
London, growth of, by J. W. Bazalgette..426
Longevity, or the natural duration of life, by Dr. W. B. Richardson..211
Longitude and ship's time..*297
Longitude, methods of ascertaining, by William Ellis, F.R.A.S..390
Looking-glass frame in oak, design for..*206
Loom alarm, stopper, Demard's..*90
Loom, buckskin, Gulcher's..*170
Loom, carpet, Gates'..*79
Loom for elastic rubber fabrics..*390
Loom harness, new, Crowell's..104
Loom, improved, Keighley's..*395
Loom, positive motion, new..*362
Loom, power, for delicate fabrics..*286
Loom-stopper alarm, Demard's..*90
Looms, revolving box for, Mounier's..*137
Looms, take-up motion for..*327
Low-water alarm, Kenyon's..*20
Lowell, Mass., founding of, by Jas. Parton..201
Lowell, statistics of wages and living in..190
Lubricants. A valuable paper, giving formulas for many patented and non-patented compositions for lubrication..316
Lubricants, testing, apparatus for..*176
Lubrication, by Prof. R. H. Thurston..70
Lubricator alarm, signal..*4
Lubricator, improved..*267
Lubricator, pulsating, Paulson's..*153
Lubricator, Royle's..*278
Lubricator, self-acting, Pickering's..*45
Lubricator, wheel-flange..*277
Lubricators, improved, Reed's..*45
Lubricators, steam pressure..*215
Lucern, value of as a farm crop..210
Lucidity, by Matthew Arnold..360
Luck, fallacies about, by Rich. A. Proctor..334
Luke Blackburn, the race-horse..*269
Lumber drier, Excelsior and Chicago..*375
Lumber flumes, construction, cost, etc..116
Lumber flumes, mountain, remarkable, of California..*95
Lumber, how to season..*373
Lumber, straw, how made..354
Luminous paint, Balmain's, its history, uses, merits, etc.; a lecture by C. W. Heaton..229
Luminous paint, how to make..249
Lunar lessons, by R. A. Proctor..395
Lunes, formula for..21
Lung, chemical, Neale's..*340
Lungs, artificial inflation of, apparatus for..257
Lyceum, or library, design for..*108

M

Macadam vs. cedar block for roads..265
Macaroni and vermicelli mach., Metzger's..*170
Machine tenders, young, hints to, by an old paper maker; practical instructions for the tending of and caring for paper making machinery. A valuable paper..79
Machine tools at the Centennial, by Joshua Rose..*44
Machine tools, Pratt & Whitney Co.'s..*38
Machine work, alteration of the form of during manipulation, cause of and how rectified. A valuable paper, by Joshua Rose..*10
Machinery, balancing of. A very valuable practical paper, of importance to all machinists, and superintendents..*368
Machinery, coal cutting..114
Machinery from an insurance point of view, by A. J. Waters..204, 205
Machinery, how to photograph..*373
Mackerel, frigate, a fish new to the New England coast..260
Mackerel, Spanish, and its artificial propagation, by Chas. W. Smiley..250
Madness, method in..299
Magic cabinet, envelopes, boxes, and portfolio, how made..*389
Magic cabinets, how constructed..*290
Magic lantern, new enlarging lens for, by J. H. Dallmeyer..*236
Magic lantern, reflecting, improved, by J. B. Knight. How to construct an exceedingly cheap, useful, and convenient lantern by which images of paper, photographs, engravings, drawings, paintings, and other opaque objects may be enlarged and thrown upon the screen..*87
Magic needles..*207
Magic portraits, how to make..*378
Magic rings, an optical illusion..*40
Magic shows in ancient Greece..*385
Magnesia, manufacture of..386
Magnet, heat generated in when it is magnetized and demagnetized, by Prof. H. A. Rowland..305
Magnet, new form of, by A. Camacho..2
Magnet, therapeutical use of, by Wm. A. Hammond, M.D..258
Magnetic "after-effect," by F. Auerbach..347
Magnetic balance, Brunner's..*386
Magnetic balance, by Prof. D. E. Hughes..429
Magnetic capacity, by Messrs. Treve and Durassier..56
Magnetic circuits in dynamo and magneto-electric machines, by Lord Elphinstone and Chas. W. Vincent..*211, 230
Magnetic disturbance, auroras, and earth currents, by Prof. W. Grylls Adams. An interesting description of the instruments used in a magnetic observatory, with an account of some of the more recent observations of magnetic disturbances with the improved methods now available..320
Magnetic field, chemical action in, by Ira Remsen..293
Magnetic inclination and declination, apparatus to determine..*160
Magnetic music teacher..*373
Magnetic needle, inclination of, first discovery of..*366
Magnetic needle, use of in searching for magnetic iron ore, by Prof. J. C. Smock..48
Magnetic ore-separating machine, impr'd..*306
Magnetic reactions by T. Du Moncel..*217
Magnetic separator, Buchanan's..*425
Magnetic station of St. Maur Park Observatory, France..*386
Magnetism..*382
Magnetism, effect of in toughening iron..256
Magnetism, evident, in iron and steel, cause of, by Prof. D. E. Hughes, F.R.S..390, *392
Magnetism, influ. on electro-deposition..*411
Magnetism, influence of on the tenacity of iron..*221
Magnetism of soft iron cylinders, influence of form on..75
Magnetism of the earth, effect upon of the sun's rotation and moon's revolution..17
Magnetism, practical experiments in, with special reference to the demagnetization of watches, by Alfred M. Mayer. An interesting explanation of the facts and principles of magnetism, illustrated by experiments made with easily constructed apparatus, and a description of a simple method of demagnetizing a watch, without detaching it from its chain..*206, *207
Magnetism, phenomena imitation of by liquid and gaseous currents, by C. Decharme..*418
Magnetism, phenomena, of compared with mechanical vibrations, by M. Stroh..*379
Magnetism, terrestrial, a new theory of, by Profs. Perry and Ayrton..177
Magnetism, terrestrial, some points connected with, by B. Stewart..240
Magneto-electric generator, De Romilly's..*352
Magneto-electric gyroscope..*233
Magneto-electric machines (see Electric machines).
Magneto-electricity for telegraphy..28
Magneto-induction machine, by Dr. Eduard Zetsche..33
Magnets, action of upon the voltaic arc, by Th. Du Moncel..*344
Magnets, bar, spirality of the energy in, by R. C. Shettle, M.D..184
Magnets, electro..*182
Magnets, electro, and induction coils, improvements in..23
Magnets, floating, experiments with, illustrating the action of atomic forces, molecular structure of matter, allotropy, isomerism, and kinetic theory of gases, by Prof. A. M. Mayer..*129
Magnets, luminosity of, by J. T. Sprague..390
Magnets, permanent, how to make..318
Magnets, powerful, how to obtain..302
Magnifying power, highest ever reached..218
Mahogany, its native country, mode of growth, and economic uses..362
Maiche, Louis, biographical sketch, with portrait..*386
Mail bag catcher, French..*53
Maize, manufacture of sugar from, by R. H. Hariand, F.C.S..356
Maize, rice, and barley, composition of..288
Majolica tiles..*107
Malaria, by J. H. Salisbury, M.D. A report of microscopical investigations of paludal exhalations, and the night vapors rising from the desiccating, freshly exposed soil of humid grounds, new prairie lands, and peaty bogs, and from the drying beds of streams, ditches, and lakes in malarious districts, resulting in the discovery of what appears to be the cause of intermittent and remittent fevers: with remarks connected with their pathology and treatment..378, 379, *380, *381, *382, *383
Malaria not of vegetable origin, by John S. Hittell..163
Malarial poisoning, chronic. A valuable clinical lecture, by A. L. Loomis, M.D..102
Mallets, French, German, and American..*257
Malt cake as food for cows..359
Malt cleaning machine, Duprez's..*113
Malt crushing mill..*402
Malthouse, new, at New York..*110
Malting, fire risks of..376
Malt sugar, or dextrine maltose, preparation and use of in brewing, by Wm. Geo. Valentine, F.C.S. A valuable paper..19, 22, 25, 28
Mammalia, extinct, remains of found in London..*373
Mammary inflammation, treatm't by ice..194
Man and evolution, by Prof. B. F. Mudge..*215
Man and his structural affinities, by A. R. Grote, A.M. A valuable and interesting paper..*148
Man and woman, an anthropological comparison of the two sexes, by G. Delaunay..309
Man, antiquity of; abstract of a paper by Alfred R. Wallace..49
Man, antiquity of, by W. Pengelly..411
Man, antiquity of, by Rev. L. J. Templin..183
Man, antiquity of in Eastern America geologically considered, by H. C. Lewis..258
Man, antiquity of in Eastern America, by H. C. Lewis..289
Man, antiquity of in England..149
Man, antiquity of, present phase of, by Prof. W. B. Dawkins..357
Man, appearance of on Pacific coast, by B. B. Redding..230
Man, arrival of in Europe, by Prof. J. Fiske..340
Man as a species, origin of, by R. Owen..365
Man, Pliocene, by Dr. C. C. Abbott..208
Man, prehistoric, in Germany..196
Man, prehistoric, present and future..236
Man, stature of..105
Man, the spiritual in..192
Manganese alloy, recipe for..210
Manganese and its uses..401
Manganese, black oxide of, as a disinfectant, by J. De Valmagini..82
Manganese bronze, by P. M. Parsons..422
Manganese bronze, malleable, for guns..31
Manganese bronze, new, Parsons'..49, 51, 187
Manganese, estimation and separation of, by Nelson H. Darton..324
Manganese, estimation of by titration, by C. G. Sarnstrom..324
Manganese in iron, estimat'n of, by S. Kern..17
Manganese, nickel, zinc, and lead, determination of by electricity, by A. Riche..92
Manganese, lead, copper, zinc, and nickel, and their alloys, estimation of, by A. Riche..147
Manganese, separation and determination of, by Prof. J. Volhard..207
Manganese, the alloys of. A review of the past history and present state of the manufacture of "crude manganese," with a description of some of the newer alloys of the metal with copper, tin, and zinc, and their characteristics and applications..293
Manganese, the position of in modern industry, by M. V. Deshayes..315
Manholes in pipe sewers, approv'd forms..*419
Mann, Horace, biographical sketch of by Mrs. Mann..133
Manometer, dry, inscribing, Brouardel's..*299
Mantel and wall ornaments, how to make, by G. M. Hopkins..*112
Mantel, design for..*51
Mantelpiece in walnut, design for..*259
Mantelpieces and grates, ornamental..*367
Manufactures, supremacy of America in..190
Manure, alkali waste as..266
Manure, barnyard, value of..70
Manure, bone and horn, how to make..75
Manure cellars and sheds..260
Manure, cotton-seed, etc..70
Manure, experiments on with rye, wheat, and oats..254
Manure for gardens, cheap..242
Manure of hens, value of..113
Manure, phosphate, by K. Walter..322
Manure, liquid, experiments in the use of..239
Manure, raw, disposal of..27
Manure, relative value, and how to apply..274
Manure, stable, thirty-eighth year of a farm without..254
Manures, potassa in, determination of..362
Manures, valuation of..75
Manuscripts, Moabite..*401
Mantides, and empusæ or May-flies..*385
Manzolini, Prof. Anna Morandi, by Madame Villarsi..124
Maple trees, propagation of..388
Marble, flexibility of..*308
Marble, stains in, how to remove..159
Marbled sepedon (snake)..*174
Marbles, onyx, of Mexico, by W. Eassie..26
Marbles, playing, how made..358
Marbling paper, the art of, by C. W. Woolnough..119
Mares, period of gestation in..298
Marine engines, Young's improvem'ts..*64
Marine propulsion, improvements in..69
Marine propulsion, theory of..12
Marine work, use of concrete in..*387
Marking ink, purple, for linen, recipe..17
Marquetry designs, Italian..*89
Marquetry for chess-board table..*68
Marquetry ornaments, designs of A. Schill..*66
Marquetry ornaments from Florence..*136
Mars, another world inhabited like our own, by Flammarion. An interesting paper..*175, 180
Mars, by T. W. Webb..218
Mars in autumn of 1877, by R. A. Proctor..*85
Mars, the moons of..93
Mars, the physical configuration of, by Prof. W. Harkness, U.S.N..*227
Marsh fever, sulphur a prophylactic of..358
Marshes, drainage of, by C. E. Hollister..429
Marshes, salt, reclaiming, by W. Clift..91
Mascaret, the..*209
Masdevallia, spectral..*384
Mash for horses, recipe for..53
Mash-tuns, false bottom for, Cave's..*366
Mason, William, the locomotive builder, biographical sketch, with portrait..*393
Masonry and brickwork, by J. C. Jefferson..148
Masonry arches..42
Masonry buildings, methods of moving..*404
Masonry, stone, and building stones, nomenclature of..*113
Masses, large, moving, by A. Rochas..*367, *417
Mastic, bituminous, applications of..276
Mastodon, recent extinction of..316
Mastodon, skeleton of, found in Kentucky..357
Mast, hollow, for yachts..297
Masts, experiments on, Kirkaldy's..*96
Matches, friction, as a cause of fire..353
Matches, how made, by John A. Garver. An interesting paper..84
Mate in Brazil..396
Materialism and its lessons. A paper by Dr. Henry Maudsley, showing that "materialism," when properly understood, far from being a menace to morality, only sets before man a higher intellectual aim than he is ever likely to reach by spiritual paths..197
Materialism, hylozoic, by Dr. R. Lewins..291
Mathematics. Inaugural address by Professor Arthur Cayley before the British Association, 1883. A valuable paper..407
Mathematics, influence of on the progress of physics, by Prof. Arthur Schuster..333
Mathematics of construction..96
Matter and life, studies of, by H. J. Slack. An interesting discussion of the discoveries that recent science has made concerning the relation of force to matter, and the connection between physical agencies and manifestations of life. 27
Matter, constitution of in the gaseous state, by Ch. Adolphe Wurtz..156
Matter, fourth state of, a refutation, by Dr. J. Puling..246
Matter, fourth state of, explanation of the phenomena of, by Dr. Zoch..260
Matter in sonorous vibration, apparatus to study the chemical stability of..*240
Matter, nature of the existence of, by E. R. Knowles..419
Matter, on a fourth state of, by W. Crookes..238
Matter, inner constitution of. Abstract of an address by Prof. G. D. Liveing..356
Maxwell, Jas. Clerk, biographical sketch, with portrait..*314
Maxwell, Prof. Clerk. Biographical sketch..210
Meal, cost of per bushel..32
Measles, a lecture, by Dr. Alonzo Clark..254
Measure, liquid, Monroy's..*378
Measures and weights, Internat'l Bureau..*407
Measures, electric, unities of, decision on..312
Measurement, base-line, by W. B. Whiting..149
Measurements, anthropometric..190
Measurements, minute, of modern science. A valuable and interesting series of articles, by Prof. Alfred M. Mayer, treating of the accurate determination, at the present day, of such quantities as lengths from 0·01 of an inch to 0·0001 of an inch and less; of durations of time from one second to a few billionths of a second; of temperatures ranging through a few thousandths of a degree; and showing in a popular way, and by the aid of diagrams and illustrations of apparatus, how these measures are made.
I. Some ideas in regard to the size of the magnitudes which it is proposed to measure..*56
II. The micrometer screw; its scientific and practical applications..*58
III. Method of measuring by means of the micrometer screw furnished with contact level..*60
IV. The spherometer..*62
V. The reading microscope, or micrometer microscope..*64
VI. Application of the compound microscope to the measurement of minute lengths..*67
VII. The vernier and vernier microscope..*72
VIII. The cathetometer and its practical applications..*77
IX. The dividing engine and the method of making accurate linear scales..*80
X. Construction of a perfect screw; manner of determining the pitch of a screw; and on our standards of length and weight..*92
XI. Application of rotating mirrors to the measurements of minute lengths, angles, and times. 1. Saxton's reflecting comparator..*96
XII. 2. Saxton's comparator applied to the comparisons of standards of length..*103
XIII. 3. Saxton's mirror applied to the observation and measurement of the changes in the dimensions of iron and steel bars when magnetized..*107
XIV. 4. Saxton's comparator applied as a thermometer..*100
XV. The horizontal pendulum..*112
XVI. Determination of the number of vibrations made in a second by a tuning fork, with examples of the use of the latter as a chronometer to mark and register intervals of time..*160
XVII. On Wheatstone's experiments to measure the velocity of electricity and the duration of the electric discharge..*165
XVIII., XIX. On the experiments of Feddersen, Henry, Rood, and Mayer on the nature and duration of the electric discharge..*168, *175
XX. On measurements of the lengths and the waves of light; preceded by accounts of the undulatory theory of light and of the phenomena of diffraction and interference of light..*177
Measuring apparatus, electric light, by R. Sabine..*387
Measuring apparatus, electrical..*329
Measuring apparatus, new form of for a laboratory spectroscope, by J. E. Reynolds..122
Measuring apparatus, Willis'..*185
Measuring devices. Descriptions of various new gauges, recorders, and indicators..*200
Measuring inaccessible heights and distances, methods of, by T. E. Candler..*313
Measuring instrumens of U. S. Coast Survey, and how used in making charts, determining the tides, etc..*29
Measuring machine, Sweet's..*25
Meat, fresh, shipment of in refrigerated chambers..15
Meat, fresh, trade in between New York and England..*90
Meat, preservation of, various methods..60
Meat, preservation of by carbonic acid..392
Meat, raw, how to prepare for invalids..64
Meat transport from New Zealand..349
Mechanical drawing (see Drawing).
Mechanical drawings, a new method of keeping, by C. T. Porter..312
Mechanical engineering, some of the developments of during the last half-century, by Sir Frederick Bramwell, F.R.S. A valuable and interesting paper read before the British Association..312
Mechanical engineering, our progress in, by R. H. Thurston..308
Mechanical labor of one man..249
Mechanical movement, a simple..*90
Mechanical movem'ts, new, by H. K. Porter..64
Mechanical science; address by Sir William Armstrong..307
Mechanics, amateur: a treatise upon tools and appliances for amateur mechanics, including a cheap and easily made lathe, drills, and drilling; tempering; drill chucks; work supports; different modes of centering; different ways of steadying work; chucks and chucking; turning and boring tools; easily made slide rest; rotary cutters, saws, and milling tools; metal shaping; wood working attachments for the foot lathe; chasing screws; knurl and knurling; spinning metals, with examples of work and tools; lens making, full description of tools and methods for small lenses; glass engraving; work in burnished brass; tools and methods completely illustrated by a large number of engravings..*311, *312, *313, *317, *318
Mechanics, practical, a series of life sketches in, showing the proper and improper methods of using tools..*88
Mechanism of a vertical attitude, by Dr. A. Nicolas..*395
Medals, how to reproduce..310
Medical Buildings, University of Halle..*308
Medical electricity, by Dr. E. G. Loring..55
Medical notes in Siam, China, and Japan, by C. W. Vrooman, M.D..115
Medical profession, hygienic and therapeutic influence of habits and character in. A paper by Edward T. Tibbets, M.D..211
Medicated ice, by Dr. J. V. Mott..73
Medicinal plants, cultivation of at Hitchin, England, by E. M. Holmes..107
Medicine bit for horses..*404
Medicine, connection of biological sciences with, by Prof. Huxley..300
Medicine in small doses, effects of, by John Morris, M.D..144
Medicine, photography in..*407
Medicine, practical, relation of experimental physiology to, by G. F. Yeo..350
Medicine, the early practice of among women, Prof. H. C. Bolton..273
Medicine, the range of the homœopathic law in, by Dr. W. B. A. Scott..97
Medicines for poultry and how to administer them..233

Medicines, proprietary, formulas for.....342
Megatherium Cuvieri, the.....*25
Melso, the most important food of the Japanese, by Prof. D. P. Penhallow.....319
Melainotypes, varnish for.....119
Melograph, or music-registering apparatus, Roncalli's.....*274
Melting-points of metals and other substances, new method of determining, by Dr. Himly..71
Melting points of the elements and their coefficients of expansion by heat, by T. Carnelly..194
Membrana tympani, rupture of. A clinical lecture, by C. R. Agnew, M.D.....245
Memory, by Dr. R. W. Brown.....429
Memory, influence of shock on, by R. O. Cowling, M.D.....218
Memphis, the Serapeum of.....232
Memphis, sewerage of, by F. S. Odell.....*284
Menhaden, short biography of, by Prof. G. Brown Goode.....194
Mennonites, thrift and progress of.....263
Mental action, automat. by Prof. J. M. Long.233
Mental depression, prolonged, disorders arising from, treatment of, by J. H. O'Reilly, M.D..144
Mental illusions.....122
Menthol crystals, preparation of.....367
Menthol for relieving pain, by D. M. Cammann, M.D.....387
Mercurial pump, autom. Couttolenc's..*239
Mercuro-cyanide intensifying process for gelatino-bromide plates.....340
Mercury, a delicate test for.....*293
Mercury, bichloride of.....213
Mercury, detection of minute quantities, apparatus for.....*241
Mercury, diiodide, effect of heat upon, by G. F. Rodwell.....168
Mercury distiller, new, Clark's.....*423
Mercury, how to distill.....*216
Mercury intensifiers, by C. I. Burton and A. P. Laurie.....319
Mercury, oleate of, for the hair, by A. H. De Young, M.D.....285
Mercury, purification of, apparatus for, Meyer's. *182
Meridian line, how to find, by R. W. McFarland. 344
Meridian, true, how to establish, by Prof. L. M. Haupt.....*360
Mesmeric experiments, by Dr. Beard....290
Mesquite bread.....258
Metal, Babbitt, recipe for.....159
Metal casts of insects, etc., how to make....311
Metal, fusible, recipe.....159
Metal, gun, strength of, experiments at Portsmouth dockyard.....100
Metal, new, actinium.....305
Metal, new, gallium.....123
Metal, new, gallium, discovery of.....*27
Metal, new, Norwegium.....192
Metal, new, zircon.....389
Metal planers, gearing for, Bilgram's....*396
Metal shaping, method of.....*312
Metal, Spence's.....222
Metal spinning.....*313
Metal surfaces, how to gild.....222
Metal surfaces, the wear of, by Joshua Rose; the conditions under which wear takes place in the running parts of machinery, and suggestions as to how it may be diminished. Valuable paper.*5
Metal working machine, Universal.....*337
Metal, thin plates of, remarkable, by Prof. Egleston.....171
Metal, wood, and stone working machines at the Philadelphia Exhibition, by J. Anderson....114
Metallic alloys, method of imparting resonance to, by Prof. B. Silliman.....12
Metallic chlorides, preparation of, by C. W. Watts and C. A. Bell.....147
Metallic compound, new (Spence's metal), by G. Cole.....222
Metallic packing, Jackson's.....*115
Metallic rings, appar. to make, Taplin's..*28
Metallic sulphides, new properties of....*212
Metallic surfaces, coating of with platinum, by the Dode process.....177
Metallic solutions, reduction of by means of gases, etc., by Dr. G. Gove.....422
Metalliferous deposits, origin and formation of, by M. Dieulafait.....394
Metalloid elements, Pictet's proposal to dissociate.....229
Metalloscopy and metallotherapy applied to the treatment of hysteria, by Prof. Charcot.....123
Metallotherapy; treatment of disease by application of metal to the skin.....82
Metallurgical processes, recent, by J. Arthur Phillips.....17
Metallurgy, gold and silver, in the United States, progress of, by T. Egleston.....333
Metallurgy, nickel, progress of, by W. P. Blake. 396
Metallurgy, photo-electro, by W. Watts. A valuable paper.....220
Metals, action of chlorine on, by R. Cowper.394
Metals, action of oils on, by W. H. Watson, F.C.S.....257
Metals and their ores; law according to which they come to, or near to, the surface of the earth, by Prof. Richard Owen.....262
Metals, annealing by electricity, machine for, Warrington's.....*9
Metals, anti-rust coating for.....235
Metals, bars and plates, testing.....428
Metals, blow-holes in, remedy for.....192
Metals, casting, centrifugal apparatus for, Tayler and Wailes'.....*299
Metals, certain, fluid density of, by Prof. W. C. Roberts and T. Wrightson.....303
Metals, change of volume of in melting.....427
Metals, coating with other metals, Morewood's process.....63
Metals, comparative toxicity of.....321
Metals, determination and separation of by electrolysis by Messrs. Classen and Von Reis.....299
Metals, determination of the equivalents of by means of their sulphates, by H. Daubigny...418
Metals, effect of water and solutions upon...206
Metals, electro-chemical analysis of.....*265
Metals, electrolytic determination of, by Ludwig Schecht.....239
Metals, embrittling, alloys of silver with, experiments on, by A. E. Outerbridge.....185
Metals, enamel mixtures for.....7
Metals, expansion and contraction of, Mayer's apparatus for measuring.....*103
Metals, flow of, by David Townsend. A record of experiments on nuts and bars punched cold, showing that an actual flow takes place in metals under pressure.....*119
Metals, fluid density of, by Prof. W. C. Roberts and T. Wrightson.....303
Metals, fusion of by electricity.....*242
Metals, galvanic deposition of, change of volume accompanying, by E. Bouty.....288
Metals, heating *in vacuo* by an electric current, phenomena of, by Thomas A. Edison.....194
Metals, how to chase and knurl.....*313
Metals, modern tools and cutters for, and systems of cutting, by W. F. Smith. A valuable paper.....*394
Metals, new method of coating with tin.....135
Metals of the ammonium sulphide group, method of separating.....211
Metals, of the platinum series, preparation of in a state of purity, by G. Matthey.....183
Metals, precious, the world's production of.361
Metals, precious, total yield of the earth since the creation.....141
Metals, precious, where they go.....19
Metals, protection of from atmospheric action by a coating of certain of their own oxides, by John Percy, M.D.....105
Metals, resistance of, by Prof. Thurston.....15
Metals, spectra of, at the base of flames, by Mr. Gouy.....68
Metals, submarine and subterranean, electric apparatus for detecting.....*357
Metals, tempering of by compression, Clemandot's process.....360
Metals, various, method of tinning.....33
Meter for electric currents, Hopkinson's...*381
Meter for liquids, Helbing's.....*371
Meter (see also Gas, Water, Velocimeter, etc.).
Meter, water, Frager's.....*259
Meter, water, Richards'.....*16
Meter, water, Schmid's.....*392
Meters for power and electricity. A lecture by C. V. Boys, explaining in plain and untechnical language the structure of measuring apparatus for power and electricity, and the manner of using them.....*404
Meters, standard, by J. E. Hilgard.....179
Meters, water, Samain's and Deplechin and Mathelen's.....*276
Meteoric dust, in Italy, observations on....249
Meteoric stones, life on, abstract of a paper by Sir W. Thomson.....92
Meteoric waters, crystallization of.....*27
Meteorite, remarkable, Emmet County....239
Meteorite, remarkable, at Estherville, Iowa, by C. U. Shepard.....195
Meteorite, Stalldaien, 1,500 feet in diameter, by Prof. Nordenskjold.....91
Meteorite, the Soko-Banja.....*200
Meteorites, gases contained in, by Prof. A. W. Wright.....18
Meteorites, huge, discovered by Nordenskjold in Greenland.....*32
Meteorites, remarkable, shown at the Centennial.....*43
Meteorites, structure and origin of, abstract of a paper by H. C. Sorby.....77
Meteorograph, printing, Theorell's.....*38
Meteorological observatory, Mt. Santis*416
Meteorological registers, by Marie-Davy. *198
Meteorology, maritime, by T. B. Maury. A paper of great interest to all navigators.....270
Meteors, an interesting account of the various theories that are and have been held regarding them.....311
Meteors, by R. J. McCarty.....*393
Meteors, Prof. Peirce on.....198
Meteors, relation of to comets, lecture by Prof. H. A. Newton.....172, 173
Methyl aniline manufacture, improvements in. 176
Methyl chloride, preparation and uses....239
Metric system: is it wise to introduce it into our machine shops? by Coleman Sellers....268
Metronome, pianograph, Hodgson's.....*350
Mexico, ancient palaces of.....*316
Mexico, Aztec ruins in.....*226
Mexico, ruins in at Palenque.....*205
Mexico, sacerdotal palaces of.....*270
Meydoom, pyramid of.....*321
Mhowah, or Mahwah, an Indian food tree...284
Mica veins of N. Carolina, by W. C. Kerr...*305
Microchemical reactions, by Dr. A. Tschirch. 361
Micrometer for microscopes, Burch's.....*152
Micrometer to read barometer curves.....*198
Micrometer screw, its scientific and practical applications, by A. M. Mayer.....*58
Micropathy, by Dr. John W. Mdclean.....283
Microphone, a simple.....*163
Microphone, action of, Prof. Jas. Blyth...*366
Microphone, an easily constructed.....*420
Microphone and telephone, some modifications of. An illustrated description, by Geo. M. Hopkins, of several simple and easily-constructed forms of the microphone and telephone in which the defects inherent to the ordinary styles of the apparatus are obviated.....*163
Microphone, cheap, for domestic uses.....*347
Microphone contacts, experiments of Stroh on.....*389
Microphone for the study of muscular contraction, Trouve and De Boyer's.....*229
Microphone, musical, by W. H. Snell.....*207
Microphone in observatories, by L. Niesten.316
Microphone, pile, by W. J. Lancaster, F.R.S. Use of the instrument in medicine; how to make a most simple and entertaining instrument; curious experiments.....*137
Microphone receivers, simple forms of, by W. J. Millar, C.E.....*178
Microphone, researches on during 1880...*269
Microphone, stethoscopic, Ducretet's.....*163
Microphone-telephone, Luedtge's.....*193
Microphone, the action of, by A. Stroh...*383
Microphone, the action of, by Prof. James Blyth, M.A.....*378
Microphone, theory of.....239
Microphone, theory of, new researches on, by Dr. Julian Ochoswicz.....*207
Microphone, torsion, Dunand's.....*350
Microphone transmitter, Wredin's.....*426
Microphone, Wheatstone's, a modification of, and its applicability to radiophonic researches, by Alexander Graham Bell.....*288
Microphonic contacts, interesting experiments on, by Mr. Stroh.....*389
Microphones, Edison's.....*163
Micro-photographic apparatus for use in chemical examinations.....*325
Microphotogrpahs, how to take, by Dr. C. Seiler.....212
Micro-photographs, how to take.....214
Micro-photography, apparatus for.....*284
Micro-photography, modern.....260
Micro-photography: description of new form of apparatus for taking microphotographs, by Dr. Ephraim Cutter.....*192
Micro-telephone, D'Arsonval's.....*370
Microscope, a simple.....*250
Microscope, an eyepiece adjunct of for use by a second observer.....*117
Microscope and some of its recent revelations, by John Rogers.....345
Microscope as a means of investigation, by Dr. Carl Seiler.....223
Microscope, binocular, for high powers, by J. T. Taylor.....*94
Microscope, compound, application of to measures of minute lengths, by Prof. Mayer.... *67
Microscope, detection and separation of silica, alumina, glucina, boric acid, the alkalies, and some of the metals by, by H. Reisch.....326
Microscope, detection of forgeries by, by Prof. J. H. Wythe.....258
Microscope, eye pieces for, improvement in, by J. H. Wythe, M.D.....*230
Microscope, impr'd, Molera and Cebrian's.*243
Microscope, improved, Waechter's.....*260
Microscope in chemistry, by H. C. Sorby...124
Microscope in writing, by R. H. Ward.....244
Microscope, life-slide for, Holman's.....*104
Microscope micrometer and its applications, by A. M. Mayer.....*64
Microscope micrometer, Burch's.....*152
Microscope, new camera lucida for.....*428
Microscopes, new stage incubator for, by Dr. H. A. Reeves.....*68
Microscope, poly, Von Lenhossek's.....*143
Microscope, rotating stage for.....*277
Microscope, solar, new, Lutz's.....*351
Microscope test-plate, Fasoldt's 1,000,000, an evening with.....244
Microscope, vernier, Mayer's.....*72
Microscope applied to chemistry.....*325
Microscopes and microscopy, by Dr. Royston-Pigott.....346
Microscopes, early, at the British Loan Exhibition.....*46
Microscopes, eye pieces for.....*399
Microscopic objects, how to enlarge and photograph, by M. A. Rutot.....83
Microscopic attachment, a simple device for the illumination of balsam-mounted objects for examination with certain immersion objects, whose balsam angle is 90° or upward, by Dr. J. J. Woodward.....*93
Microscopic slide, a new, by Ernest Vanden Broeck.....*32
Microscopic vision, Abbe's new theory of, observations on, by J. W. Stephenson.....*81
Microscopical examination, preparation of materials for, by Dr. Carl Seiler.....227
Microscopy: list of plants which afford raphides, sphæraphides, long crystal prisms, and short prismatic crystals, by G. Gulliver.....94
Microscopy, new field for, by W. S. Kent..*126
Micro-telephone, Trouve's.....*156
Microtome, freezing, Lewis'.....*83
Microtome, freezing, Taylor's.....*358
Middlings, mill for softening.....*67
Middlings purifier, Sutcliffe's.....*28
Middlings purifiers, Benoist's, Westrup's, Cabanes', and Ferrigault's.....*101
Middlings purifiers, Excelsior.....*185
Middlings purifier, electric, Osborne's....*235
Middlings, separation by air currents....*101
Mildews and moulds, by Dr. A. G. Field....308
Milk, adulteration of, by Dr. H. A. Mott, Jr. A comprehensive and valuable paper.....60, *71
Milk analysis, Gerber's apparatus for....*73
Milk as a carrier of diphtheria.....210
Milk, apparatus for determining the quantity of water in.....*228
Milk as a vehicle of contagion, by A. R. Becker, M.D.....160
Milk as food.....106
Milk, bovine and human, difference in action and composition, by C. Husson.....392
Milk beer, how to make.....218
Milk, condensed, how made.....156
Milk, condensed, report on, by Dr. August Voelcker.....320
Milk, cow's, digestibility of.....428
Milk diet as a remedial agent.....84
Milk, elephant's, composition of, by Dr. C. A. Doremus.....288
Milk establishment for 50 cows, design for.*289
Milk, fermentation and putrefaction of, by T. J. Burrill.....200
Milk house, cheap, how to construct.....30
Milk, medical uses of.....226
Milk, method of analyzing, by E. H. Von Baumhauer.....*73
Milk, methods of analyzing, by E. Peligot.*377
Milk, methods of preserving.....139
Milk, method of testing the purity and richness of with gypsum.....318
Milk, new mode of analyzing.....153
Milk mirror, the Guenon; the external marks by which may be known the amount of milk a cow will yield and the length of time she will hold out in her flow.....*275
Milk, mule's, analysis of, by Prof. A. Duges.352
Milk, new points in the production of.....264
Milk, optical apparatus for testing, Mitteilstrasse's.....*261
Milk separator, Danish.....*321
Milk tree of Venezuela.....*206
Milk-tester, centrifugal, Lefeldt's.....*219
Milk, why it sours during thunderstorms, by M. W. Iles.....107
Milking apparatus, Blurton's.....*147
Mill buildings, practical hints on, by R. James Abernathy.....7
Mill buildings, oscillation and vibration of, and how to remedy.....217
Mill, cotton, Boott, at Lowell, Mass.....*221
Mill, flour, Oliver Evans' model of 1783....*163
Mill for crushing malt, etc., improved.....*402
Mill for softening middlings.....*67
Millers, useful items for.....234
Milling, American, by Andrew Hunter....289
Milling machine, Brainard.....*46
Milling machine for gun work, Bement's...*43
Milling machinery and methods, improved, by J. F. Gent; also porcelain rollers for milling.*162
Milling machines and tools, by J. Rose....*16
Milling methods, American, ten years' progress in, by Albert Hoppin.....303
Milling, new process of.....111
Milling questions and answers.....229
Milling, roller, theory of, by Gustav Pappenheim.....*200
Milling tools and emery wheels, flies versus, by J. Rose.....63
Mills, sugar-cane, improved.....*156
Millstone dress and dressing tools.....*190
Millstone dressing machine, Dupety's....*182
Millstone, a model dress for.....*369
Millstone, spindles, pulleys and pinions for.210
Millstones, the ventilation of.....96
Millstones, theory of the grooves in.....*178
Mimicry, protective, in animals and plants, by Prof. Mivart.....254
Mimicry, protective, in bats.....72
Mimulus cupreus.....*410
Mind, absence of, as a sign of incipient mental disease.....233
Mind, failure of, some of the causes of.....123
Mine accidents, mechanical appliances for, by C. Hawksley and E. B. Marten.....*105
Mine, amber, sinking a pair of shafts for.... 2
Mine, Bassic, Colorado.....*214
Mine, Calumet, standpipe of.....*371
Mine, Comstock, bonanzas of.....57
Mine, Comstock, by A. P. Schack. An interesting account of this famous lode, illustrated with several figures, showing vertical sections...*73
Mine, Comstock, by J. S. Hittell.....*29
Mine, Comstock, heat of, by J. A. Church....165
Mine, Emma.....109
Mine, O'Neil, concentrating mill at.....*394
Mine, Providence, the Monnier process of ore reduction at.....*84
Mine, quicksilver, Guadalupe.....81
Mine, the Candelaria.....56
Mine ventilator, Root's.....*100
Mineral analysis, Muller's improvem't in.249
Mineral deposits, the Comstock lode.....199
Mineral dresser, Canfield's.....*45
Mineral localities in the vicinity of New York city, by N. H. Darton.....344, 349, 363, 415
Mineral phosphates as fertilizers.....128
Mineral wool, the manufacture of.....310
Mineralogy, microscopic, by J. Girard.....*11
Minerals and organisms, distinct'n between.345
Minerals, application of organic acids to the determination of, by Dr. H. C. Bolton.....137
Minerals, carbon, origin and relation of, by J. S. Newberry.....362
Minerals, discoveries of in Western North Carolina, by John T. Humphreys.....241
Minerals, how to prospect for, by J. E. Clayton, M.E.....200
Minerals, liquid carbonic acid in, by W. N. Hartley.....*23
Minerals, metallic, production and uses of, by J. Yelloly Watson.....54
Minerals, new, by Dr. H. Wurtz.....165
Miners' lingo; definitions of the terms used by miners.....181
Mines, appar. for ascending or descending.*367
Mines, blasting and blown-out shots in, by W. Purdy.....*256
Mines, blowers, or outbursts of gas in, by W. Purdy.....*265
Mines, coal, of Trinidad.....412
Mines, coal, ventilating chambers, automatically closing.....*361
Mines, coal, working by electricity.....402
Mines, compressed air in.....140
Mines, gold, of Siberia.....*326
Mines, gold, Plumas County, Cal.....68
Mines, mechanical ventilation of.....22
Mines of old Mexico.....389
Mines of the Land of Midian.....129
Mines, quicksilver, of California, geology of, by L. Wagoner.....375
Mines, salt, wonderful, of Nevada.....25
Mines, silver and coal, remarkable, of Peru.*86
Mines, silver, in New England.....69
Mines, South Park.....108
Mines, tin, of Perak.....399
Mines, ventilator for, Swiss.....*70
Mines, zinc, of Lancaster Co., Pa.....89
Mines, zinc, of Sussex Co., N. J., by N. H. Darton. 393
Mining and smelting, cost of, by W. Belshaw. 51
Mining at West, how profits are absorbed in. 29
Mining cages, wire rope for.....*247
Mining, coal, at Mt. Diablo, Cal.....191
Mining, coal, at Steubenville, Ohio.....72
Mining claims, how located and described; who may take up claims on the public lands, and how it should be done.....89
Mining claims in Colorado, by Richard A. Parker, C.E., giving an outline of the method and requirements of claim surveying in the mining regions of the West, and pointing out the inducements that Colorado offers as a field of operations for the civil engineer.....*289
Mining, electric exploding apparatus for.*319
Mining engine, Fowler's.....*131
Mining fumes, Californian.....*322
Mining, gold, by Thos. Price.....319
Mining, hydraulic, at Dutch Flat.....48
Mining, hydraulic, in California.....*106
Mining in Arizona and in N. Mexico.....114
Mining in Boulder County, by F. L. Vinton.120
Mining laws of the United States.....103
Mining machinery, heavy.....117
Mining operations at Flood Rock, Hell Gate.266
Mining process, Monnier.....*84
Mining project, great, the combination shaft. 94
Mining pump, Blake's.....*63
Mining regions of the West, by Prof. W. P. Blake.....220
Mining shafts, Kind-Chaudron process for sinking and tubing, by Julien Deby. A valuable exhibit of the cost, methods, and tools employed, with 21 illustrations.....*82
Mining, sinking through aqueous strata in, without pumping machinery.....89
Mining stamps, Californian.....*95
Mining, use of lime in instead of powder..*403
Mining wedge for the extraction of coal, Elliott's.....*120
Minneapolis, explosion of Washburn mill at, in 1878; view of ruins, particulars, etc.....*133
Mint, U. S., at Philadelphia, Pa., description of its various departments.....117
Mirror, astronomical, mercury, Collin's....*36
Mirror frame, carved, design for.....*265
Mirror of Japan and its magic quality, by Prof. W. E. Ayrton.....*179
Mirror, Saxton's, applications of.....*107
Mirror, toilet, Nuremberg, after design by Prof. C. Schick.....*357
Mirrors, magic, of silvered glass.....*338
Mirrors, rotating, applied to minute measurements.....*165
Mirrors, silvering, improvem't, Lenoir's....206
Mirrors, value in photographing interiors..225
Misereres in Lincoln Cathedral.....*231
Mississippi, improvement of, by J. B. Eads, C.E.....116, 305
Mississippi River alluvial basin of, by Gen. Henry L. Abbott.....*14
Mississippi River, alluvial basin of; review of report of U. S. Levee Commission, by Jas. B. Eads.....*11
Mississippi River and its tributaries, early history of, by J. W. Spencer, Ph.D.....384
Mississippi River jetties.....*28
Mississippi River, jetty works at the mouth of, by E. D. Cortell, C.E.....*21
Missouri, Columbia, and Colorado Rivers, wilderness at the head of, by C. F. Blackburn..183
Missouri, little bad lands of.....*427
Missouri, mound discoveries in, by C. W. Stevenson.....132
Missouri River navigation, preliminary report upon the improvements in, by Major Chas. R. Suter.....280
Mitrailleuse, Nordenfelt, marine and campaign types of.....*294
Mixing and kneading machinery, imp.....*215
Mixing machine for concrete.....*408
Model-making, hints on.....317
Model farm in Normandy.....150
Model of palace in which Peter the Great was born.....*142
Model school, North Adelaide.....*108
Modeling in clay, by Edward A. Spring. A valuable set of rules and directions, by the study of which almost any one can soon learn to practice this art with success.....181
Models and casts, a new material for.....378
Moistening apparatus for spinning and weaving rooms.....*352
Molecular physics in high vacua. A paper by William Crookes, describing a remarkable series of experiments, tending to show that there exists in nature a fourth and higher condition of matter as much more ethereal than the gaseous condition as the gaseous state is higher than the liquid.....*189
Molecular physics in high vacua, contributions to, by William Crookes; magnetic deflection of molecular trajectory; laws of magnetic rotation in high and low vacua; phosphorogenic properties of molecular discharge.....*243, *244
Molecular weights, a new method of determining, and the results obtained by it, by Edward Vogel.....317
Molecules, Crooke's discov. concerning...*181
Molecules, size of, by N. D. C. Hodges.....192
Moles, how to remove from the skin.....162
Molybdic solution, observations on the preparation and use of, by M. Kupfferschlaeger...326
Monet, Louis. Biographical sketch, with portrait.....*286
Money, how made, by A. E. Outerbridge, Jr. Interesting account of the processes employed at the United States Mint.....182
Mongoose and cobra, by G. A. Stockwell...424
Monitor, submarine, electrical, Tuck's.....400
Monkeys. An interesting paper, by Alfred R. Wallace.....344
Montezuma, birthplace of, by T. S. Case.*263
Montgolfier brothers, notes on the lives and characters of, by Dupuy De Lome.....413
Monument by R. Dietelbach, Stuttgart...*309
Monument, German national, on the Niederwald, at Bingen, with full particulars of erection. *406, *412
Monument in St. Stephen's Cathedral, Vienna, *411
Monument, German, War and Peace.....*415
Monument to General V. Goeben.....*424
Monument, with wrought iron inclosure, by Walther.....*117
Monuments and inscriptions of American history in Yucatan.....*322
Monuments of Yucatan, are they ancient or modern, by A. Le Plongeon, M.D.....*405
Monuments, sepulchral, marble, in Genoa*142
Moon, apparent distance of.....250
Moon, is it inhabited? By Camille Flammarion. 169, 170
Moon, rainbow rings about.....*419
Moon, supposed changes on the.....222
Moon, the, not a dead star, by Dr. Hermann J. Klein.....223
Moon, tidal evolution of, by Dr. Ball.....302
Moon, variation in motion, caused by the earth's spheroidal figure, by D. P. Blackstone.....*138
Moonlight, by Richard A. Proctor...*95, *99
Mordant, new, for fixing coloring matters.. 89
Mordant, new, for Turkey red.....91
Mordant, silicic acid as.....93
Morin, Gen. Arthur Jules. Biographical sketch, with portrait.....*228
Morphine in opium, determination of, by E. F. Terschunacher.....99
Mortar, action of lime on the silica in.....210
Mortar and cement, strength of.....46
Mortar carriage and truck, for sea-coast batteries.....*33
Mortar mixer, Gubbins'.....*315
Mortar mixer, steam, Barrowe and Stewart.*53
Mosaic work, Cork Cathedral....*214, *224
Mosque of St. Sophia.....116
Mosquitoes, oil for preventing attacks of..344
Moss copper, by W. M. Hutchings.....71
Moth, vacuna.....*150
Mother-of-Pearl and pearl inlaying.....317
Moths entrapped by an asclepiad plant (Physianthus), and killed by honey bees.....212
Moths, preservation of goods from.....323
Motion, falling, origin of, by Charles Morris.240

Motion, link, the inventor of....274
Motion, perpetual....*410
Motion timer, suggest'n for, by J. W. See.*12
Motive power, electricity as, by Prof. Ayrton. 198
Motive power, gas versus steam as....322
Motive power, transmission of, data concerning various methods....68
Motor, air, Beaumont....238
Motor, air, gas, and steam, Simon's....*168
Motor, ammonia, Gamgee's....*281
Motor, caloric, Ericsson's....*70, *218
Motor, caloric, Rider's....*49
Motor, caloric, Sachsenberg....*162
Motor, caloric, Todt's....*284
Motor, caloric, Van Renne's....*247
Motor, compres'd air as, by W. H. Massey.*323
Motor, compressed air, Beaumont's....*248
Motor, dynamo, for electric generators....*327
Motor, electric, Bessolo's, and Siemens' opening electro-magnetic....*431
Motor, electric, Bürgin's....*323
Motor, electric, Deprez's....*212
Motor, electric, new, by W. W. Griscom....267
Motor, electric, pendulum, Higg's....*58
Motor, electro, Chutaux's....38
Motor, electro, Elias'....*315
Motor, electro-magnetic, Deprez's, by Th. Du Moncel....190
Motor, electro-magnetic, Egger's....*78
Motor, electro-magnetic, Sawyer's....*19
Motor, electric, Trouve's....*259
Motor for small boats....*158
Motor, gas and steam, Simon's....*182
Motor, gas, Benier's....*289
Motor, gas, Clerk's....*310
Motor, gas, cost of work'g, by F. T. Linton.248
Motor, gas, Cropper's....*95
Motor, gas, Crossley's....*117
Motor, gas, Dowson's....*411
Motor, gas, Edwards'....*404
Motor, gas, Ewins and Newman's....*360
Motor, gas, Forcet's....*426
Motor, gas, Gilles'....*44
Motor, gas, Lang and Otto's....*27
Motor, gas, Otto's....*146, *282
Motor, gas, Ravel's....*276, *313
Motor, gas, Roots'....*51
Motor, gas, steam, and air, Simon's....*168
Motor, gas, Turner's....*218
Motor, gas, theory of....336
Motor, gas, Wordsworth's....*380
Motor, hydro, or vessel propelled by water jets. *308
Motor, hydrocarbon, Brayton's....*58
Motor, light, for balloons....*286
Motor, oscillating, for pump....*376
Motor, prime, electro-magnetism as....359
Motor, sun, Mouchot's....*167
Motor, water-meter, Hutter's....*297
Motor, water-pressure, Hastie's....*180
Motor, water, Wigzell and Pottit's....*270
Motor, wind, "Tourbillon"....*330
Motors and elevators, hydraulic, by B. F. Jones. 392
Motors and producers, gas, Siemens'....*324
Motors, compressed air, by Jas. Young....*309
Motors, compressed air, for street cars, by Gen. H. Haupt....176, 177
Motors for rolling mills, Davey's....*391
Motors, gas, at Paris Electrical Exhibition..307
Motors, gas, Böttcher's....*302
Motors, gas, Buss, Sanbart and Co.'s....*265
Motors, gas, early, notes on....417
Motors, gas, efficiency of, by Thos. Holgate.368
Motors, gas, water gas for....303
Motors, spring, for sewing machines....*142
Motors, spring, Steel and Austin's, Leveaux's, Schumacher's, Jones and Terfloth's, Shoemaker's, Frahm and Scharnweber's, Doubler's, Bacon's, Moeslein's, Howell's, and Lathrop's. *46, *47, *48, *50
Motors, steam (see Steam Engines).
Motors, the cannon, steam engine, man, and the insect as....414
Motors, wind, economy of....335
Mouflon, the....*209
Mould as an insect destroyer, by C. G. Siewers. 203
Mould, green, of cheese, fruit, etc....*271
Moulds for casting in fusible alloys, how to make, by G. M. Hopkins....*17
Moulding and dovetailing machine, Anderson's. *347
Moulding and founding apparatus, Jackson and Co.'s....*48
Moulding machine for wheels, Scott's....*80
Moulding mach., Gallas and Aufderheide.*306
Moulding machine, Sebold and Neff's....*246
Moulding machine, universal....*337
Moulding, ornamental, from Salisbury Cathedral....*191
Moulds for copper objects, machine for....*429
Mound builders and the Aztecs....318
Mound builders, by W. H. Pratt....298
Mounds, prehistoric, Kansas....168
Mountains, Green, age of....228
Mountains of California coast, origin of....428
Mount Etna, eruption of....*189
Mount Etna, present state of, and the Valle del Bove....*306
Mounting material, good....172
Moving large masses, by A. De Rochas....*367
Mowers and reapers, a classification of, to assist purchasers and juries in making decisions as to the respective merits of the different machines in the market, by A. L. Kennedy, M.D....*184
Muck, swamp, nature of and value in agriculture, by Dr. J. R. Nichols....320
Muck, the delusion concerning....301
Mulberry trees, how to cultivate as food for the silkworm, by Mrs. V. C. Haven....325
Mule for cotton spinning, Lee's....*395
Mule spindle duplex, improved....*379
Muller, Max, biographical sketch of, with portrait....*128
Mullein, use of in the treatment of pulmonary consumption, by Dr. F. J. B. Quinlan....415
Multiplication simplified; rules for quickly finding the products of any number of digits multiplied by any other number without resorting to the usual lengthy method....227
Mummies and Egyptian antiquities from Thebes....*151
Mummies, etc., from Peru. Notes on a collection from the cemetery at the Bay of Chacota, by John H. Blake....*151, *152
Mummy garlands, flowers of....374
Mummy head and Egyptian antiquities from Thebes....151
Muscle exercise, apparatus for, Zander's...*134
Muscles, contraction of, microphone to study *229
Muscular action, heat in....97
Muscular strength, variation in, by F. E. Nipher....1
Museum, American, of natural history....376
Museum, Bethnal Green, London....267
Museum, Commercial, Brussels, by Consul John Wilson....355
Museum, geological, Columbia College School of Mines....190
Museum, National, Washington....258
Museum, Peabody, the collections of....143
Museum, Zoological, at South Kensington, London....*228
Mushrooms. A valuable paper, giving full directions for the cultivation of this esculent, either on a small scale for family use, or on a large one for the market....*178
Mushrooms, how reproduced, by W. G. Smith. *15
Music, an inquiry into the laws of the beautiful in, by Prof. H. A. Clarke....270
Music, apparat. for printing by electricity.*265
Music, medical uses of, by Dr. George L. Beardsley....376
Music printing plates, method of preparing...89
Music registering apparatus, Roncalli's....*274
Music teacher, magnetic....*373
Music, theory, experiments affecting....401
Musical instruments, electrical, at the Centennial....46
Musical sand....124
Musical telegraph, La Cour's....*10
Musical tones, transmission of telegraphically, by Elisha Gray....*6
Musk, interesting information about....391
Musket, balloon, Krupp's....*40
Mustard, examination of, by C. T. Gage...*225
Myopy, or short sight, treatment of....*136
Mythologic philosophy, by Prof. J. W. Powell. 193, 194

N

Nails, finger, changes in the lines of during sickness....130
Nails, how to drive, by D. Blanchard....267
Nails, miter-cut, how manufactured....6
Napier, James R., the shipbuilder. Sketch of of his life and labors....214
Napier, Robert, biographical sketch, with portrait....*40
Napmeter, Kittary's, for testing the durability of cloth....*39
Naphthalene, preparation of....183
Naphthalin as a wound-dressing, by Dr. G. R. Fowler....372
Narcotics and stimulants used in Asia....398
Nasal catarrh, by Dr. F. H. Bosworth. A valuable paper....262
Nasmyth, James, biographical sketch of....380
Natural history notes: Arctic fox; reindeer and musk-ox; walrus; seal; wolf-like dog. 12
Natural history notes; New mammalia of the Puerco formation; growth of plants in acid solutions; salt-water insects used as food; crayfish; bottle-nose whale; squealing toad; electric fish; elephant's revenge....402
Natural laws, harmony and application of, by B T Giraud....351
Nature forces, action of, by Prof. Geikie....202
Naval and Submarine Exhibition, London.*335
Naval battle between the Peruvian ironclad turret ship Huascar and Chilian ironclads....*212
Naval forces, German and Amer. compared.. 5
Naval signaling, Morse alphabet for....45
Navigation. Abstract of a lecture by Sir W. Thomson....69
Navigation, aerial, and its possibilities, by T. Choinski....*283
Navigation, aerial, by F. Barnett....372
Navigation, aerial, by F. W. Breary..191, 240
Navigation, history of, from the lacustrine pirogue up to sail vessels of the 19th century, by Admiral Paris....*410
Navigation, problems of, new instrument for solving, by T. Hill....*20
Near-sightedness, causes of, by Prof. B. G. Northrop....122
Nebula, great, in Andromeda, as figured by Bond in 1847, Trouvelot in '74, and by Perry in '81.*338
Nebular theory; abstract of lecture by Prof. Benj. Peirce....173
Necrophori, or burying beetles, by J. Fletcher. 323
Necropolis, new, Madrid....*176
Needle, dipping, original discovery of....*366
Needles, how made....*54
Needles, magic....*207
Needlework, the art of, by Mary W. Willis. 89
Negative films, transfer of to paper....72
Negative paper process....284
Negative, retouching, improved, by G. F. E. Pearsall....103
Negatives and ferrotypes, removing varnish from....17
Negatives, combination, by L. Warnerke....51
Negatives, conversion of directly into positives. 286
Negatives, flexible....195
Negatives for single transfer carbon printing, reproduction of....310
Negatives, gelat., formula for intensifying.213
Negatives, gelatine, by Rev. H. J. Palmer...124
Negatives, gelatine emulsion, development of, by H. J. Newton....383
Negatives, gelatine, how to develop and intensify....409
Negatives, gelat., intensifying with silver....329
Negatives, gelatine, novel method of intensifying....419
Negatives, gelatine, retouching....295
Negatives, glass, direct prints from...118, 131
Negatives, how to detach from their glass supports....178
Negatives, how to remove the varnish from. 40
Negatives, intensification of....340
Negatives, intensify'g by exposure to light..232
Negatives, multiplication and reproduction.303
Negatives, novel method of intensifying...341
Negatives, opaque, how to weaken, by E. Rienel. 70
Negatives or positives, gelatine, intensification of with silver....329
Negatives, panoramic, large, by means of small camera and lenses, by L. Warnerke....36
Negatives, paper....95
Negatives, paper, by Capt. W. De W. Abney.119
Negatives, paper, how to make....135, 401
Negatives, paper, process, by W. Brooks....284
Negatives, pellicular and gelatine plates....276
Negatives, prepara., of from line drawings.123
Negatives, reproduction and multiplication of, by Ernest Edwards....303
Negatives, reproduction of for single transfer carbon printing, by W. T. Wilkinson....310
Negatives, reproduction of without a transparency....242
Negatives, retouching, by F. E. Pearsall....103
Negatives, reversed, by contact printing....373
Negatives, transfer of....239
Negatives, transferring, reversing, and transporting....28
Negatives, varnish for....169
Negatives, washing and fixing....381
Negatives, wet plate, of line engravings, intensification of....419
Neophonography, a practical system of shorthand for every day use, by J. Richardson....316
Nerve and muscular reactions, electrical, a new meth. of producing, by W. J. Morton, M.D.*302
Nerve-stretching in sciatica....134
Nerve surgery, Gluck's studies in....133
Nerve vibration as a therapeutic agent, by J. Mortimer-Granville, M.D....341
Nerves, animal, development of as studied in the chick, by A. M. Marshal....99
Nerves, divided, reunion and restoration of, by Dr. C. G. Wheelhouse....147
Nervous control, equilibrating value of, by Dr. J. T. Searcy....357
Nervous diseases, organic, treatment of by tribasic phosphate of silver, by Dr. A. McLane Hamilton....277
Nervous disease, morbid fear as a symptom of, by G. M. Beard, M.D....194
Nervous disease, the climate cure in, by W. F. Hutchinson, M.D....213
Nervous exhaustion, by George M. Beard, M.D. A very valuable paper....135, 136
Nervousness, its nature, and different degrees and peculiarities under which it exists....102
Nest-building, is it an instinct in birds? By R. T. Lowne, F.L.S....198
Neural analysis, Jaeger's; an operation by which the muscle nerve indicates what the nerve of smell smells and what the nerve of taste tastes, with diagrams showing the curves produced by the inhalation of various odors..*256
Neuralgia, cure of by nerve stretching....205
Neuralgia, ether spray for, by Dr. McColganan. 352
Neuralgia, facial, cure of. Account of an interesting dental operation—resection of the inferior dental nerve—performed by Dr. J. E. Garretson for the cure of facial neuralgia....*167
Neuralgia, facial, extirpation of superior maxillary nerve and Meckel's ganglion for, by Dr. G. R. Fowler....92
Neuralgia, how it should be treated, by Dr. J. W. Hickman....196
Neuralgia, obstinate, excision of the inferior dental nerve for the relief of, by Jas. E. Garretson, M.D....*258
Neuralgia, remedy for....18
Neuralgia, treatment of with tonga....227
Neuralgia, hypodermic injections of carbolic acid in, by Dr. Merten....51
Nevada, aluminum in....427
New Caledonia, notes on....429
New Guinea and the Admiralty Isles....*16
New Orleans, disposal of garbage at, by Rev. H. M. Thompson....228
New York city, the islands about....268
New York State, watersheds of....225
New Zealand and the United States, trade between, by Consul G. W. Griffin....318
Niagara River, its canon, its depths, and its wear by W. H. Ballou....316
Niaudet, Alfred, electrician, brief sketch....413
Nicotine in tobacco, estimation of....*174
Nickel, adulteration of, how to detect by the magnet, by Prof. T. T. P. B. Warren....353
Nickel and cobalt, color relations of, by James Bottomley....245
Nickel and cobalt, Fleitmann's process of rendering malleable....224
Nickel and cobalt, how to distinguish in a mixed solution, by Dr. G. Papasogli....222
Nickel and cobalt, new method of separating, by A. Guyard....58
Nickel and its alloys, determination of....147
Nickel, determination of by electricity....92
Nickel, electro depos. of, by H. Fontaine....425
Nickel, electro deposition, Weston's process.192
Nickel, Garnier's process for rendering malleable....260
Nickel, its uses and qualities....210
Nickel metallurgy, prog. of, by W. P. Blake..396
Nickel plated goods, causes of scaling in and remedies therefor, by L. Metzger....152
Nickel plating on iron and steel without a battery, method of....153
Nickel salts, Terrell's process for preparing.. 39
Nickel, separation of from cobalt, by G. Vortmann....389
Nickelizing without electricity, recipe for..191
Niger, discovery of the sources of by Zweifel and Moustier....*274
Night-sweating, picrotoxin in....223
Niobrara group, by Chas. H. Sternberg....293
Nitrate of zinc pencils, how to make....14
Nitrogen, determination of in hair, wool, dried blood, flesh meal, and leather scraps, by Dr. C. Krauch....315
Nitrogen, hydrogen, and atmospheric air, liquefaction of, by M. Cailletet....112
Nitrogen, liquefaction of....386
Nitrogen, new method of determining, by J. Kjeldahl....405
Nitrogen, new method of producing, by J. W. Gatehouse....71
Nitrogen, organic, in liquids and solids, estimation of, by W. Bettel....*323
Nitrogen; preparation; chemical and physical properties; distribution; and compounds, by J A. Pooley, F.C.S....279
Nitrogen, solidificat'n of, by S. Wroblewski.424
Nitrogen, the supply of, by W. D. Philbrick.186
Nitric acid as a cause of spontaneous combustion....287
Nitric acid and its salts, by Dr. A. Geyger....98
Nitric acid, reproduction of from the lower oxides of nitrogen, by Bernard C. Molloy; new and economic process of converting the lower oxides into nitric acid again in manufacturing enterprises, in which the acid is used as an oxidizing agent....165
Nitroglycerine, explosives containing, analysis of, by F. Hess....342
Nitroglycerine, manufacture of....243
Nitrous acid during evaporation of water..296
Nitrous oxide disinfecting apparatus....*291
Nocturnal animals. An interesting paper by James Muire, M.D., LL.D....*199
Nomodont, or curve of limiting numbers..370
Nordenskjold, Adolf Erik, biographical sketch, with portrait....*209, *409
Nordenskjold's expedition; successful northeast passage of the Vega, with portraits of Prof. Nordenskjold and Capt. Palander.*231, *232
Nordenskjold's winter experience and observations....202
North American continent, early history of. Address by C. H. Hitchcock before the American Association....405
North Carolina, undeveloped mineral resources of....318
Northwest, the old; historical and industrial development of Ohio, Indiana, Illinois, Michigan, and Wisconsin....218
Norweglum, new metal....192
Nose ape, the....*389
Notes on cranberries; apples; thinning fruit; making grafting-wax; profits of fruit growing; tar walks; and blackberries....126
Numerals, origin of our....5
Nut and bolt forging machine, Horsfall's....*94

O

Oak carvings, how to remove paint from..413
Oak casket, carved, design for....*232
Oak, poison, of California, by James G. Steele. 95
Oak-stain for shoe-bottoms, recipe for....167
Oak staircase and screen....*176
Oak, the cork....*167
Oasis, a new, Abu-Naim, in the Sahara, discovered by Dr. Gerhart Rohlfs....261
Obelisk; full account of the removal of Cleopatra's needle, Alexandria to New York...*267
Obelisk in Central Park, how it was suspended and placed in an upright position....*2, 68
Obelisk, launch of, and loss at sea....96
Obelisks, by Prof. T. L. Donaldson....126
Obelisks, Egyptian, and their relation to chronology and art, by B. H. Cooper....*119
Obelisks, Egyptian. An interesting article, on the purposes, mode of construction, and erection of monoliths in general, and a history of Cleopatra's needle in particular....*223
Obesity, exercise as a remedy for....409
Obesity, its nature and treatment, by J. J. Mulheron, M.D....210
Obesity, how caused, how cured....166
Obesity, plans for reducing: diet, exercise, specific medicines....227
Obesity, remedy for....366
Objective, photographic, electrical....*411
Objective, Tolles' 1-75, its history, construction, and uses, by Dr. E. Cutter....180
Objective, useless part of.—Stop, new, by F. Stolze....*304
Observatory, astronomical, Rochester....*254
Observatory, Royal, description of its apparatus....245
Observatory, meteorological, New York..*209
Ocean basins, physical cause of, by O. Fisher323
Ocean bottom, interesting organisms found at by the Challenger expedition....*35
Ocean waters, circulation of; abstract of paper by Sir Wyville Thomson....146
Octopus, giant, of the west coast of America, model of....*389
Ocular estimation; experiments showing the curious errors that every one is liable to make in mere ocular estimation of distance and position....*24
Ocular symptoms in different diseases, by Dr Gorecki....297
Odors and their recognition, by W. J. Slater.364
Odors, strong, how to remove from hands....105
Œsophagus, stricture of, gastrotomy in, by Dr. W. Thomson....*147
Oil, anthracen, treatm't of, by A. McD. Graham.18
Oil, apparatus for cleansing, Koellner's....*258
Oil belt, Santa Clara Co., California....205
Oil, Canangu, or Ilang-Ilang, by F. A. Flückiger....*288
Oil, castor, substitute for....226
Oil, cod-liver, amount of iodine in....325
Oil, cod-liver, substitute for....226
Oil, colza, electric discharge through, by A. Macfarlane....308
Oil, cotton seed, manufacture of, its history and progress....329
Oil, cotton seed, preparation of....190
Oil, cotton seed, purification of....246
Oil district of Bradford, Penn., by Chas. A. Ashburner....198
Oil, ethereal, of California bay-tree, by J. M. Stillman....235
Oil from the bottle-nosed whale, by A. H. Allen, F.C.S....371
Oil, fusel, detection and estimation of....365
Oil gas, compressed, for lighting cars, steamboats, and buoys....*324
Oil gas, retort for, Drescher's....*310
Oil, influence of in calming surface of sea....373
Oil, linseed, and electrified oxygen....241
Oil, linseed, for protecting iron....223
Oil, linseed, how to assay....412
Oil mill, improved....*421
Oil mill machinery, improved....*376
Oil of wood, by Mr. Guibourt....44
Oil, olive, adulteration of....368
Oil, olive, adulteration in, how to test for, by Michael Conroy, F.C.S....*287
Oil, olive, how clarified....300
Oil, olive, how to detect adulteration in....319
Oil, olive, how to detect cotton seed oil in....243
Oil, olive, methods of testing, by Dr. O. Bach.392
Oil, paraffin, in pharmacy....310
Oil of bitter almonds, volatile, by Prof. W. L. Dudley....230
Oil of ginger, essential, by J. C. Thresch....308
Oil of peppermint, Japanese....367
Oil of turpentine from pine cones, apparatus for distilling....*216
Oil of turpentine, resin, and tar, process of making, by Isidore Zacharias....105
Oil of wintergreen, how made....336
Oil paintings, how to copy....144
Oil paintings, deterioration of, by R. Liebreich. Description of the structure of paintings and the methods of different schools; the injuries, decays, and chemical changes to which paintings are liable, and the best methods of restoration, with useful suggestions to artists how to paint durable pictures....149, 151
Oil pressing machinery; an account of methods employed in crushing oil from seeds, with a description of improved machinery for the purpose. Illustrated with plans and sections of an oil mill in England, and the various apparatus used therein....*293
Oil regions of the United States, life in, by Boverton Redwood, F.C.S....184
Oil sand, Bradford, by C. A. Ashburner....169
Oil stones, how manufact'd, by H. Y. Beach.*19
Oil, substitute for, in preparing wool....91
Oil tank fires, from lightning, and suggestions for their prevention, by Henry Morton....330
Oil wells, how sunk....124
Oil wells, how bored....388
Oils and oil wells of Burmah, a paper by Dr. James M. Robertson....223
Oils, appa. for testing, Ingram and Stapfer's.*68
Oils, cotton seed, colza, and rape, purification with alkalies....246
Oils, detection and determination of, by M. A Kelmont....246
Oils, essential, adulteration of....367
Oils, essential, concentrated, patent....370
Oils, essential, distillation of....*292
Oils, essential, mode of detecting alcohol in.. 95
Oils, essential, new mode of extracting, by L. Naudin....*406
Oils, essential, processes of obtaining....63
Oils, fatty, action of upon copper, by W. H. Watson, F.C.S....105
Oils, fixed, methods of examining, by W. Fox, F.C.S....398
Oils for watches....105
Oils, hydrocarbon, separation of from fat oils, by A. H. Allen, F.C.S....307
Oils, lubricating, apparatus to test, Bailey's.*160
Oils, lubricating, friction of....246
Oils, lubricating, new treatment of....77
Oils, mineral, apparatus for testing....*12
Oils, mineral, in the cleansing of tissues....82
Oils, mixed, method of testing....7
Oils, or mixtures of, for lubricating, method of analyzing....299
Oils, petroleum; character and properties of the various distillates of crude petroleum....288
Oils, processes for purifying with alkalies, by M. Biondeau....246
Oils, volatile, chemical examination of. A paper by Prof. W. L. Dudley, giving in a compact form the properties and tests which are accepted by chemists and pharmacists as the most reliable for the various impurities contained in volatile oils....287
Ointment, citrine, preparation of, by J. U. Lloyd....190
Ointments from vaseline, recipes for....153
Olearia gunniana (shrub)....*342
Oleic acid, preparation of....58
Oleojector, Royle's....*278
Oleomargarine, how made....322
Olive culture....120
Olives, culture of....253
Omnibus, a new design for....*268
Onions, culture of....226
Onions, how to grow....222
Onyx marbles of Mexico....26
Onychia maligna, cure for....159
Opal glass, photography applied to....401
Opal printing, emulsion for....367
Opals and argentic paper, enlargements on..415
Opera glass, pocket, new....*365
Opera House, Holyoke, Mass....*119
Opera House, new, Paris....*94
Opera House, National, London....*61
Opossum, by Howard Miller....27
Ophthalmia, infantile, how to prevent....196
Ophthalmometer, new....*383
Ophthalmoscope, how used....*130
Ophthalmoscope, its structure and use....*32
Opium, determination of morphine in....99
Opium, analysis of, rapid process....325
Opium habit, nature and treatment of, by Dr. E. Mann....304
Opium, preparation of for smoking....252
Optical illusion, experiment showing....*285
Optics. By F. A. Hamilton....*210
Orang-outang, the....*260
Orang-outangs at the Garden of Acclimitization in Paris....*205
Orange culture in Florida....227
Orange tree scale.—Scale on fruit trees, remedy for....370
Oranges and orange flowers, by W. B. Bush..183
Orchid, Galeandra nivalis....*336
Orchid, moth, the greater....*426
Orchids and howling monkeys.—Whale skeletons at the Paris Museum....*327
Ordnance, heavy, construction of....172
Ordnance, modern, by Colonel Maitland....324
Ore concentrating mills at O'Neil mines, Kansas....*394
Ore concentrator, or vanning mach., Frue's.*104
Ore deposits of Leadville, Col., by Carl Henrich, E.M....167
Ore deposits, origin and classification of, by Dr. J. S. Newberry. A very valuable paper....223
Ore extraction, Monnier process of....*49
Ore furnace, Eames'....*45
Ore jigger, Hancock's....*17
Ore reduction, the Monnier process of, at the Providence mine....*84
Ore separator, Buttgenbach's....*381
Ore stamps, Californian....*95
Ore stamps, pneumatic, Scholl's....*67
Ore stamping machines, relative efficiency of different kinds....92
Ore-washing machine of the Curzon (France) iron works....*140

Ore-washers, Taylor's *83
Ores and minerals of the United States represented in the Smithsonian collection 46
Ores, gold and silver, dry process of working, Paul's *38
Oreide, new substitute for gold, composit'n.. 19
Organ, flame, or pyrophone *357
Organ, great, Temple Church, London 370
Organic compounds artificial, syntheses of, by J. M. Stillman 165
Organic forms, artificial production of 374
Organic substances, preservative for, Wickersheimer's 318
Organisms and minerals, distinction betw.. 345
Organisms, living, ultimate structure of, by Dr. Carl Seiler 252
Organisms, minute, relations of to certain specific diseases, by Prof. Klebs 303
Organs, hydraulic, ancient *354
Ornament for ceiling *89
Ornament, real and manufactured, in architecture 108
Ornament, what it is, what it means, and what makes it good or bad, by H. H. Statham 426
Ornamental details, by Prof. A. Brausewetter, Reichenberg *339
Ornamental details in relief, by Prof. A. Brausewetter *302
Ornamental emblems in cast iron *277
Ornaments, building, in cement, preparat'n. 44
Ornaments, carved, from the Waldemir fountain, Ratisbon.—Panel ornaments, 17th century. *43
Ornaments, etched on arms and utensils.. *351
Ornaments for decorative painting *202
Ornaments for panels *81, *82
Ornaments for the mantel and the wall, how to make, by G. M. Hopkins *112
Ornaments from Salisbury Cathedral *191
Ornaments in etching for an iron casket.. *321
Orthoclase, or common feldspar, nature, varieties, and uses of 72
Osmogene, Selwig and Lange's, for clarifying sugar *347
Ostrich feathers, bleaching of 192
Ostrich feathers, dyeing, by Paul Alex 255
Ostrich parks of Algiers *200
Ostriches and ostrich farming, by M. A. Mathew. 56
Ostriches, shipping of from Cape Town to Australia *401
Otter, sea, habits of *395
Oven, baker's, gas-heated, new 401
Oven, coking, Aitken's *65
Oven, portable, Macalpin's *248
Ovens, glass-melting, notes on 116
Ovens for bread, Lamoureux's *371
Overstrain in iron and other metals, new method of detecting, by R. H. Thurston.. *138
Owl-critic, the, by J. T. Fields 186
Oxalic acid in fungi, by W. M. Hamlet 92
Oxen, Hereford *4
Oxygen and hydrogen, liquefaction of, by Raoul Pictet 128
Oxygen, apparatus for production of from atmospheric air by dialysis, Margi's *367
Oxygen, electrified, and linseed oil 241
Oxygen, free, in water, method of determining, by J. Koenig and C. Krauch *258
Oxygen from bleaching powder, apparatus for making *314
Oxygen in the air, deficiency, insensibility from, by Dr. W. Wallace 386
Oxygen in ebullition, temperature obtained by, by S. Wroblewski 424
Oxygen in steels, by S. Kern 89
Oxygen in the sun, Prof. Draper's account of the discovery of 193
Oxygen light, production of *419
Oxygen, lines of, identity with solar lines, by Prof. Henry Draper 194
Oxygen, manufacture of 119
Oxygen, manufacture of from atmospheric air, Brin process *300
Oxygen, presence of in metallic silver, by Mr. Dumas 118
Oxygen, retort for, Chadwick's *77
Oxygen, the active condition of 335
Oxygen, liquid, density of 113
Oxyhydrogen light, experiments on 6
Oxyhydrogen light, zirconia for 93
Oyster, the enemy of the 95
Oyster eggs, artificial fertilization of 210
Oysters, artificial propagation of 345
Oysters, rearing of from artificially fertilized eggs, together with notes on pond-culture, etc., by John A. Ryder 422
Oysters, sewage in, by Dr. C. A. Cameron.. 300
Ozokerite, its origin, composition, and technical uses, by Dr. List 36
Ozokerite, or earth-wax, deposits in Europe and America, by W. L. Lay 401
Ozonator, new, Leeds' *171
Ozone and the atmosphere, by Albert R. Leeds. A valuable and important paper *154
Ozone, liquefaction of, and on its color in the gaseous state, by P. Hautefeuille and J. Chappuis 255
Ozone, lines of discovery in the history of. A valuable paper, by Albert R. Leeds, Ph.D.. 222
Ozone, liquefaction of, and its color in the gaseous state, by Hautefeuille and Chappuis 271
Ozone, transformation of into oxygen by heat, by Ira Remsen 336
Ozone, production of by heating substances containing oxygen, by Dr. A. R. Leeds 272
Ozonizer, electrical, Leeds' *203
Ozonometer, thallium paper as 275

P

Pacha, decapitated, how constructed *375
Packing, metallic, Jackson's *115
Packing, piston, Giffard's *19
Packing, rubber, how to render tight 339
Paddles, screws versus 198
Pain, obtunding of by rapid breathing 275
Paint, anti-corrosion, for iron, recipe 415
Paint, blistering of, causes of and remedies. 387
Paint from a sanitary point of view, by Dr. H. C. Bartlett. A paper pointing out the dangers arising from inhalation of the poisonous particles given off by white lead in dwellings.. 154
Paint, how to renew without burning 392
Paint in construction, by Robert Grimshaw. A valuable technical paper 125
Paint, luminous, Balmain's, by C. W. Heaton, F.C.S. 229
Paint, luminous, how to make 249
Paint, old, how to remove 359
Paint, photographic, for machinery 366
Paint, removal of from oak carvings 413
Paint, roofing, recipe for 113
Painting, atmosphere and space in, by G. A. Storey *394
Painting, carriage, by W. H. Stewart 100
Painting, carriage; how can the present method be improved, by W. H. Stewart *98
Painting, decorative, ornaments for *202
Painting, fresco, designs for *102
Painting, locomotive, by J. S. Atwater 358
Painting, oil, photo-litho, or chromotype.. 65
Painting on china, methods and rules of. A valuable paper 199
Painting on glass, directions for painting upon ground glass for window ornaments, etc., and upon transparent glass for lantern slides.. 219
Painting on porcelain, notes on 182
Painting on wood, general hints 213
Paintings and writings, faded, new method of restoring 134
Paintings, oil, old, how to clean 125
Painings, oil, the deterioration of, by Dr. R. Liebreich 149, 151
Paints, colored, from thallium 120
Paints without poison, by E. Turpin 112
Palace of Fine Arts, Rome *377
Palace of Justice, new, Brussels *123
Palace in which Peter the Great was born, model of *142
Palaces, ancient, of Uxmal, Mexico *316
Palaces, sacerdotal, of Mictlan, Mexico.. *270
Palæontology, Americ. and Yale College.. 212
Palæontological discovery, history and methods of, by Prof. O. C. Marsh. A valuable and interesting paper 193, 194
Palæontology, modern, present condition and the future task of, by Carl Vogt 249, 250
Palazzo Vendramin-Calergi, Venice *381
Palate, cleft, congenital, hard rubber appliance for, by Thomas Brian Gunning, M.D *144
Palenque, Mexico, ruins at *205
Palenque tablet, Raus', by O. T. Mason 230
Palisades, geology of, by A. E. Hoppock .. 316
Palmetto, medical use of 293
Palliser, Sir W. Brief account of his life and of his labors in improving guns, projectiles and armor 324
Panama canal, scenery along *418
Panax victoriæ *385
Pandermite, a new boracic mineral, by C. G. W. Lock 267
Panel, cast iron, design for *340
Panel from communion table, design for.. *272
Panel ornaments, carved *249
Panel ornaments, carved, by F. Kiefhaber .. *36
Panel ornaments, carved, from Gothic stalls, Tarnow Cathedral, Galicia, 15th century .. *50
Panel ornaments, designs for *81, *82
Panel in construction, by R. Grimshaw 125
Panels in walnut, carved, designs for *323
Panemone, a new wind motor *403
Pantheon at Rome, Raphael's tomb in *385
Pantograph, Fenby's *242
Pantograph, new, by C. W. MacCord *424
Panzerkanone, or masked gun, Krupp's .. *59
Paper and ink, fireproof 158
Paper and wood, how to crystallize 34
Paper bags, method of manufacture *191
Paper bags, waterproof, how to make 25
Paper, blotting, how made 17
Paper canes, how to make *353
Paper, collodio-chloride 111, 414
Paper, color designs on *331
Paper, copying, how to make 153
Paper cutter, Brown and Carver's *34
Paper, electric, how to make 274
Paper, expansion of 231
Paper, fly, sticky, recipe for 159
Paper for bank bills and bonds, how made .. 290
Paper, fumigating, how made 159
Paper, gelatine, aniline fuming for 226
Paper, history of 374
Paper, how to coat with gelatino-chloride or bromide, by T. G. Whaite *331
Paper, how to coat with photographic preparations 339
Paper, how to dye with aniline colors 89
Paper, how to marble 119
Paper, how to waterproof 96
Paper, how waterproofed 39
Paper, luminous 398
Paper-making, improvements in 287
Paper making in Maine 363
Paper negatives (see Negatives).
Paper, photo, how to silver 63
Paper, photographic, sensitized, treatment.. 369
Paper, photo-lithographic, by J. Husnic 83
Paper pulp, black, how to make 249
Paper pulp, boiler and process, Roeckner's .. *44
Paper pulp machine, Lebrousse's *170
Paper, ready-sensitized, treatment of 369
Paper, rice, Chinese, how made 151
Paper-ruling machines, Hickok's *396
Paper, test, for ammonia, new and delicate. 326
Paper, test, use of in disease, by Dr. W. H. Bentley 290
Paper, thallium, as an ozonometer 275
Paper trade, technology of, by William Arnot. An interesting treatise, giving full and practical particulars regarding every department of paper making, and describing the most recent and best processes and machines in use.. 109, 110, 116, 117, 118, 123
Paper, wall, arsenical, and artificial flowers, dangers from 272
Paper, wall, ornamental, designs for *310
Paper, water-mark in, origin of 294
Papers, ornamental, machines for the production of, Tulpin's *211
Papier mache, application of to the bottoms of iron ships 65
Papin, Denis. Biographical sketch, with engraving of the bronze statue recently erected to him at Blois, France *254
Papyrograph, the 225
Papyroxyline, formulas for 110
Papyri, Egyptian, discovery of 298
Paraffin, amorphous 379
Paraffin oil, heavy, in pharmacy, by Charles Symes, Ph.D 310
Paraffin splints, by W. MacEwen, M.D 145
Paraffin, method of manufacture 119
Parallel curves, by Prof. C. MacCord *420
Parallel rod, standard, for locomotives .. *295
Paralysis and convulsions as effects of organic disease of the brain, by C. E. Brown-Sequard, M.D. A series of eight celebrated lectures delivered at the Bellevue Hospital Medical College, 101, 102, 103, 104, 109, 112, 119, 121
Paralysis, cure of by nerve stretching 68
Paralysis, saturnine, elimination of lead in. 81
Paranthracene, a new organic substance sensitive to light 375
Paris, cleansing of, by Mr. Vaissiere 64
Paris Exhibition, curiosities of 145
Paris Exhibition prizes, 1878. Full official list of the awards in the American department, enumerating exhibits and names and addresses of exhibitors, with kind of prize awarded.. 149, 150
Paris green as an insecticide, how to use 400
Paris green, how to apply to plants 144
Park, Yellowstone Nat., attractions .. 230, 407
Parkesine, xylonite or celluloid 227
Parliament building, Berlin, design for. *55
Parliament building, Berlin, designs for. *358
Parrot, a sheep-eating 322
Parrot, New Zealand.—Bat, fruit, collared.—Potto, Van Bosman's *199
Parsonage, design for *389
Passenger cars of Mt. Vesuvius Railway. *235
Passengers, ejectment of from cars, decision on. 186
Passengers, rights of at stations 262
Passiflora, Professor Eichler.—Spathiphyllum hybridum *387
Passionflowers and their culture 406
Paste for scrap-books, recipe for 159
Paste, Sieburger's recipe for 169
Pasteboard, drying apparatus for *314
Pasteboard, how to waterproof 267
Pasteur, Louis, brief biographical sketch of, with portrait *335
Pastures, improving, hints on 80
Pastures, worn out, how to treat 185
Patent law, German, new, text of 80
Patent laws, the policy of. An able paper by F. H. Betts, read before the Social Science Association at Saratoga in 1879 197
Patent Office fire, subsequent repair of the burned models 136
Patent Office, reorganization of, speech of Hon. O. H. Platt 432
Patents, State laws concerning the sale of, decisions of the U. S. Courts in regard to 25
Pathological anatomy, the role of, by Prof. J. Cohnheim 201, 203
Pattern designs, method of transferring to copper plates or rollers 62
Patterns for carpets, veteran *331
Patterns for door panels of iron stoves, design for *63
Patterns for fabrics from Munich Museum. *347
Patterns, propeller, new method of making. *92
Pattern-raising machine for wool cloth.. *207
Pavement-rammer, steam, Johnson's *21
Pavement, road, new, by M. K. Couzens 38
Pavement, mosaic, in Cork Cathedral *224
Pavement, mosaic, Siena Cathedral *294
Pavements, asphalt, in Washington 334
Pavements, foot-walk, the best, by E. Buckham, C.E. 82
Pavements, street, by Gen. Q. A. Gillmore. 15
Pavements, street, comparative efficiency and cost of various kinds in use, by F. Shanly .. 33
Pavilion, cricket, design for *297
Pavilion, Judges', at the Centennial Exhibition. *8
Pavilion, Women's, at the Centennial *8
Peabody Museum, Yale College, New Haven, Conn.; description of the building and some of the objects of interest that it contains *88
Peach, culture of 88, 340
Peach-borer, mulching for 320
Peach trees, how to prune properly, by Prof. S. T. Maynard *29
Peach trees, treatment of 63
Peaches, notes on 208
Peanuts, how to cultivate 97
Pear grit as a cause of anal irritation *393
Pearl, how to inlay on iron 224
Pearl, inlaying of 317
Pearls, artificial, how made 10
Pears and apples, how they bear fruit. *419
Pears, valuable suggestions in regard to ripening and marketing 147
Peat as a gas making material 419
Peat charcoal, manufact. of, works for. *137
Pea-weevil, larval state of, notes on, by T. H. Hart *354
Pegging-jack for shoemaking *197
Pegging machines for shoes *197
Peirce, Prof. Benj. Biographical sketch .. 257
Pen, electric, improved *414
Pen, electric, or horograph *183
Pen, electric, a simple *166
Pen, pneumatic, improved *49
Pencil, adding, Leuner's *170
Pencil, adding, Smith and Potts' *34
Pencil, lead, manufacture, history of 157
Pencils, colored, how made 185
Pencils of silver nitrate, how to make 81
Pendulum, electric, motor, Higgs' *58
Pendulum, horizontal, Zollner's *112
Pendulum, improved, Redier's *73
Pendulum, regulator, electric, Tahler's .. *153
Penn, John, the eminent mechanical engineer, biographical sketch, with portrait *151
Penn, William, grave of *302
Pennsylvania Steel Co., description of the works of 333
Pens, steel, how made 50
Pepper, Cayenne, microscopic study of, by T. Greenish *258
Peppermint, Japanese, by E. M. Holmes .. 388
Pepsin, how to prepare, by Dr. J. Adolphus. 161
Perch, climbing *244
Perchloric acid, researches on, by M. Berthelot. 316
Percolating and filtering stand, new, by Joseph P. Remington *109
Perforating and folding machinery, Lawrence's. *132
Perfume pomades, how prepared *288
Perfumery, by W. A. Saunders. A valuable and practical paper upon the preparation of perfume extracts, with formulæ for the preparation of the most prominent and popular perfumes now on the market, directions for the preparation and compounding of the ingredients, etc 65
Perfumery for the handkerchief, a large number of choice recipes for 281
Perfumery, flowers used in. An interesting paper by W. A. Wrenn, to which is appended numerous formulæ for making choice perfumes for the handkerchief 380
Perfumery, a choice collection of formulæ for, by Alex. B. Levi, Ph.G 202
Perfumes and essential oils, by Laurent Naudin, describing a new mode of extracting essences and perfumes by volatile solvents with the aid of a vacuum and cold 406
Pernettyas.—Lilies and their culture *373
Perpetual motion *410
Perpetual motion, Gamgee's *281
Perry, Prof. John, biographical sketch, with portrait *335
Persia, life in 184
Perspective and its application to artistic drawing. A paper by J. R. Allen, giving by aid of a series of models an explanation of the fundamental laws of perspective, and inquiring how far they are applicable to artistic drawing. *403
Perspective in one lesson, by H. F. Liebbe. A valuable paper, giving a clear exposition of the principles of perspective, with a full page of figures to illustrate the rules *64
Peru, American engineering in, by W. H. Cilley. 126
Peru, wonderful railways of, by Dr. Heath. 165, 166
Peruvian antiquities, by Dr. E. R. Heath. A valuable and comprehensive paper containing many facts not hitherto known 158, 159
Petrolatum in officinal ointments 409
Petroleum, amount of remaining in Pennsylvania and New York, by H. E. Wrigley *341
Petroleum and coal blast furnace, Caldwell. *8
Petroleum and its examination; a new mode of analysis of petroleum and its products, by A. Bourgougnon *204
Petroleum and its products 386
Petroleum as fuel 331
Petroleum benzin in pharmacy, by L. Woiff.. 58
Petroleum, conveyance of by pipe lines. Locations of the lines and total mileage of pipe employed 50
Petroleum, chronology of. Interesting facts regarding the early history of the petroleum industry and its present status 323
Petroleum, crude, in consumption 242
Petroleum, deodorizing, Johnson's method. 39
Petroleum, how to examine, by F. Skalweit. *283
Petroleum, illuminating gas from, manufacture of, by T. S. C. Lowe *2
Petroleum in Peru 232
Petroleum in the Old World 228
Petroleum locomotives, Urquhart's *63
Petroleum oils, interesting facts about 288
Petroleum products, apparat's for separating, Cole's *51
Petroleum, statistics of in the U. S., by Dr. C. F. Chandler 17
Petroleum tester, Skalweit's *283
Petroleum wells, how bored 388
Petroleum wells, how sunk 124
Petroleum wells, steam in, by W. L. Hardison. *9
Pharaoh's serpents, how made *259
Phænacodus primævus (fossil) *389
Pharmacology and therapeutics. Notes on the therapeutic action of valdivine, cedrine, sparteine, tayuya, bergenin, hyoscin, hellebore. 318
Pharmaceutical education better, by Richard V. Mattison 154
Pharmaceutical laboratory, small, equipment and working, by G. F. Schacht *99
Pheasant, ocellated *360
Phenakisticope, Plateau's *253
Phenakisticope, projecting, Molteni's .. *354
Phenetol and its derivatives, by Prof. E. J. Hallock 403
Phenic acid for snake bite 357
Philippium, a new metal, by Marc Delafontaine 154
Philosophy, mythologic, by J. W. Powell. 193, 194
Phœnicia, archæological discoveries in 216
Phonetidoscopic experiments, new; production of iridescent figures of vowel sounds.. *219
Phonetidoscope, how to construct. *137, *145
Phonodynamograph, applications of the principle of, by William B. Cooper *350
Phonograph, a lecture on, by Prof. J. W. S. Arnold. An interesting paper *119
Phonograph and its future, by Thomas A. Edison 124
Phonograph, how to make; full instructions, with eight working drawings, half size; construction easy and inexpensive *133
Phonograph, speaking, Edison's 115
Phonography, Neo, a practical shorthand for everyday use, by J. Richardson *316
Phonoscope and the phonetidoscope for showing the action of sound waves *137
Phosphate manure, by K. Walter 322
Phosphate mines of South Carolina 322
Phosphates, Charleston 186
Phosphates, mineral, as fertilizers 128
Phosphates, source, manufacture, and efficiency of 82
Phosphates, value of for the grain field 75
Phosphor-bronze and its applications 79
Phosphor-bronze, properties of and value for certain purposes 45, 48
Phosphorescence *186
Phosphorescence, marine 42
Phosphorescent animals, facts and thoughts about *197
Phosphorescent powder, recipe for 226
Phosphorescent substances, how to prepare. 318
Phosphorescent tablet as a standard light, by A. Spiller 374
Phosphoric acid, manufacture of 268
Phosphoric acid, notes on the determination of, by Carl Mohr 343
Phosphorus, by Dr. Anton von Schrötter.. 104
Phosphorus, mode of manufacture and properties of 65
Phosphorus, neutralization of in steel and steel-like metals, by R. Brown 202
Phosphorus, properties, modifications, combinations, and distribution of 203
Photo-bath, quick 65
Photo-block printing, improvements in.. *423
Photo-burnishing 51
Photo-copying, by John Nicol, Ph.D 4
Photo-cement, Straub's 51
Photochromo pictures 121
Photocollotype process 174
Photo-developing dish, Williams' *341
Photo-electric apparatus for medical studies. *406
Photo-electro metallurgy, by W. Watts. 220
Photo-engraving, by David Bachruch, Jr. 138
Photo-engraving, by J. Waterhouse 158
Photo-engraving, Dawson's method 366
Photo-engraving, electric, by J. Waterhouse. 143
Photo-engraving, grain in 268
Photo-engraving, Gillot's method 112
Photo-engraving, improved, Michaud's. 184
Photo-engraving in half-tones 141
Photo-engraving, new method, Garnier's. 312
Photo-engraving on zinc or copper, by Leon Vidal 344
Photo-engraving process for surface printing, by H. Knight 217
Photo-enlarging, new departures in 408
Photo-enlargements on canvas 250
Photo-exhibits of the South London Photographic Society 110
Photograph enlargements *149
Photograph, instantaneous, by E. Bolvin.. 138
Photograph, ten feet long, and how albumenized 63
Photographers, physiological hints to 128
Photographic action, spectroscopic study of. 391
Photographic-camera lenses, improvement in, Steinheil's *47
Photographic establishment of Wm. England *230
Photographic field-glass, new *332
Photographic films, how to strip from glass. 258
Photographic gun, Marey's *336
Photographic Hall at the Centennial *10
Photographic image, latent, substances that have the power of developing, by M. C. Lea. 239
Photographic image, what it is, by Dr. T. H. Morton *288
Photographic lens, new, Voigtlander's. *116
Photographic notes; Intensifying; copying photos at night; side-lights; blotting-paper; a good developer; photo-burnishing; photo-transparencies; good mucilage 61
Photographic notes: Mr. Warnerke's new discovery; method for converting negatives directly into positives; experiments on the sensitiveness of coal oil; bitumen plates; method for topographic engravings; succinate of iron developer; method of making friable hydro-cellulose .. 286
Photographic preparations, coating paper with 339
Photographic printing process, Portuguese. 138
Photographic printing, roller frame for. *359
Photographic prints, how to render transparent 297
Photographic prints, a new process for 217
Photographic residues, how to collect and work up *377
Photographic wastes, reduction of 346
Photo-lithographic process, Butter's .. 227
Photographing by gaslight, by J. Urie 222
Photographing colors 216
Photographing interiors 121
Photographing machinery 373
Photographing on a scale of nature, optical requirements for 319
Photographing on wood, by J. T. Taylor .. 428
Photographing sounds, the possibility of .. 39
Photographs, antimony, how made 22
Photographs, beetroot 166
Photographs, enameling or glazing 47
Photographs, encaustic, on porcelain, glass, etc., new process 134
Photographs for studying movements of animals *404
Photographs, glass, preparation of for colors, by G. C. Lewis 29
Photographs, how to color and preserve, by J. A. Schultz 95
Photographs, how to glaze 47
Photographs, how to impart an artistic finish to, by E. Dunmore 6
Photographs, how to mount, by W. B. Woodbury 83
Photographs in colors 19
Photographs in colors, by Dr. H. Vogel 109
Photographs, insects destructive to *111
Photographs, instantaneous, Muybridge's apparatus for taking *334
Photographs, instantaneous, Muybridge's. 317
Photographs, largest in the world 17
Photographs, magic, developed by tobacco smoke, how made *359
Photographs of animals in motion, Muybridge's. 317
Photographs of microscopic objects, how to take, by Dr. Carl Seiler *212
Photographs on wood for engraving, by E. Pocock 53
Photographs, relief printing blocks from. 429
Photographs upon enamel and porcelain, how to take 48
Photography, aerial 103
Photography and the industries, by H. W. Vogel 247
Photography applied to terra cotta and opal glass 401
Photography, asphalt for, experim. with.. 243
Photography, astronomical 335
Photography by lightning 89
Photography by the electric light, by H. Van der Weyde 334
Photography, ceramic 429
Photography, detective 404
Photography, drawing room 358
Photography, enamel 382
Photography in and out of the studio.—Measuring the force of explosives by photography. 88
Photography in colors, by K. Versnaeyen. 175
Photography in colors; instantaneous pictures; hints to ferrotypists 111

Photography in lace factories.—Dry plates, substitute for glass in.—Negatives, opaque, how to weaken.—Photo hints: Caution in washing prints; stoppers for varnish bottles; production of special bust pictures; net-like cracking of the film; retouching powder.....70
Photography in medicine, by A. Londe..*407
Photography in natural colors, Albert's process.....131, 156
Photography in natural colors, by H. Vogel.109
Photography in natural colors, by O. Von Kramer.....156
Photography, instantaneous.....83, 93
Photography, instantaneous, apparatus for, Candeze's.....*353
Photography, instantaneous, lion's head taken by.....*383
Photography, instantaneous, Muybridge's experiments in.....135
Photography, isochromatic.....*402
Photography, microscopic, applied to chemistry.....*325
Photography of colors, by F. E. Ives.....216
Photography of machinery.....373
Photography of oil paintings.....144
Photography of the invisible.....259
Photography of vision, by W. S. Bird.....184
Photography, porcelain, by J. R. Sawyer..256
Photography; positives, how to take in the camera direct.....293
Photography; positives, transparent, a new method of taking, by Capt. Biny.....307
Photography, printing surfaces and pictures by.....143
Photography, progress of in Russia.....161
Photography, recent advances in, a lecture before the Society of Arts, by Capt. Abney.....237
Photography, recent applications of in the industries.....247
Photography, relief in, exaggeration of...139
Photography, retouching in.....139
Photography, solar, a new method of.—Stains, bichromate, how to remove from the hands.386
Photography, solar, reversed action of light in.....248
Photography, "spirit".....15
Photography, stellar, at Harvard.....400
Photography, tele, by S. Bidwell.....*290
Photography upon canvas.....315
Photogravure, Goupil's process.....269
Photogravure, photo-relief plates for, method of reproducing.....*418
Photogravure, Scamoni's process for.....125
Photo-lantern, Stebbing's.....*227
Photo-light equalizer, De la Noe's.....*376
Photo-litho oil paintings, or chromotypes, how to make.....65
Photo-lithographic process, Asser's.....92
Photo-lithographic process, by H. Butler.227
Photo-lithographic printing, as performed at Woolwich.....257
Photo-lithography.....247
Photo-lithography, hints on.....317
Photo-lithography, how performed.....284
Photometer, astral, new, Espin's.....*397
Photometer, dispersion, Perry's.....*283
Photometer, electric, Vidal's.....*270
Photometer, fire-damp, elect., Liveing's. *253
Photometer for studios, Monckhoven....*204
Photometer, Munzinger's.....*8
Photometer, new, Napoli's.....*237
Photometer, Pentane.....*379
Photometer, refraction, Fuchs'.....*284
Photometer, Sabine's.....*387
Photometer, simple, how to make.....*250
Photometer, universal, Hartley's.....*393
Photometer, Woodbury's.....*220
Photometer, Zenger's.....*421
Photometric measurements at Munich Exhibition.....*409
Photometric measurements, approximate, of sun, moon, sky, and electric and other artificial lights, by Sir William Thomson.....370
Photometrical researches, Cornu's.....*294
Photometry of the sun and other lights....379
Photometry, the eye as an aid in. An interesting paper, showing how light affects the eye, and within what limits this organ can judge differences of illumination.....*408, *409
Photo-micrography, by George E. Davis, F.R.M.S. A practical treatise on the art of taking photographs of microscopic objects....*284
Photo-micrography, by T. C. White....*376
Photo-micrography without a microscope or microscopic objective.....*391
Photo-microscopy, monochromatic light in, by Capt. Abney.....95
Photo notes. How to remove silver stains from clothing; prevention of blisters on albumen paper; silvering of glass; taking impressions of negatives; washing of photographic silver pictures in zinc vessels; a new gold salt for photography; the dry coffee process; chloride of palladium process.....83
Photo-paper, formulas for.....17
Photo-paper, sensitive, preserving.....19
Photophone, an interesting account of the researches of Willoughby Smith on selenium, and of the subsequent development of Bell and Tainter of a new branch of philosophical inquiry—photophonic science.....*270
Photophone, a paper by Alexander Graham Bell, describing a new apparatus for the production and reproduction of sound by means of light, and explaining principles involved....246
Photophone, construction of.....*271
Photophone, exper. with, by A. Jamieson.*278
Photophone, Mercadier's researches on....280
Photophone, theory of.....*283
Photophonic phenomena, Bell on....*281
Photophonic transmitter, Berliner's..*264
Photo-plate holder, cheap, how to make, by L. Macdona.....*38
Photo-plate process, new.....126
Photo-plates, Edwards' process.....341
Photo-plates, instrument for coating....*336
Photo-plates, manufacture of.....373
Photo-plates, starch, Ferrars and Pauli's...198
Photo-plates, wet and dry.....388
Photo-plates—Woodburytype—the old and the new.....243
Photo-printing and photo-plates, by J. V. Suverkrop.....382
Photo-printing in Munich; Albert's establishment.....304
Photo-printing plates, how to make, by T. Bolas.....167
Photo-printing process, new, the Despaquis method.....93
Photo-printing process, simple, by Mr. Gobert.119
Photo-printing process, Woodbury.....213
Photo-printing processes, Portuguese....138
Photo-process, new, Poitevin's.....219
Photo-reliefs, Scamoni's method of reproducing.....*418
Photo-rheometer for determining the unit of light.....*336
Photo-tracings in black and color.....286
Photo-transparencies, excellent, how to make, by E. Stebbing.....*155
Phthisis, a lecture, E. G. Janeway, M.D...246
Phthisis, acute, curability of; Dr. McCall Anderson's treatment.....77
Phthisis, forced feeding in.....369
Phthisis, treatment of by benzoate of soda..226
Phthisis, topical medication in.....286
Phylloxera in California.....246
Phylloxera, life history of.....*167
Physical exercise, its value for health, by Dr. Charles Cathcart.....369
Physical law, thoughts on our conception of, by Prof. F. E. Nipher. An able and interesting essay.....168
Physical phenomena, by W. J. Millar. A discussion of the properties and nature of certain manifestations that are brought prominently before us in studying our physical surroundings: force; matter; motion; space; time; momentum; velocity; energy.....272
Physics, atomic, a problem in, by Prof. J. Tyndall.....367
Physics, influence of mathematics in the progress of.....333
Physics, molecular, in high vacua, by William Crookes, F.R.S.....*189
Physics, solar, Sir W. Siemens on.....394
Physics without apparatus. An interesting series of illustrated articles, showing how to perform numerous instructive experiments, in every department of physics, by means of common articles found in every household, no other apparatus being required. By following the directions given, any person may go through an entire course of experimental physics.....*229, *232, *237, *243, *247, *250, *253, *262, *266, *271, *279, *284, *297, *302, *321, *353, *363, *388, *410, *423
Physiognomy, human, developmental significance of, by E. D. Cope.....*392
Physiological knowledge, by Prof. Huxley. 88
Physiological station, Paris, by E. J. Marey. *408, *414
Physiology, experimental, by Dr. Robert Meade Smith. An interesting paper.....*161
Physiology, experimental, relation of to practical medicine, by G. F. Yeo.....350
Physiology, food, and force, by Dr. E. L. Sturtevant.....186
Phytochromotypy, or art of taking impressions of plants.....*410
Piano, cottage, design for.....*239
Piano, upright, design for.....*100
Pianoforte, history of, an elaborate and valuable paper, by A. J. Hipkins.....*385
Pianograph-metronome, Hodgson's for transcribing music.....*350
Piassava fiber.....249
Pickling machine for plate, Taylor.....*75
Pie-plant, or rhubarb, culture of.....262
Pier, Huelva, of Rio Tonto Railway.....127
Pier, iron, U. S., near Lewes, Delaware, by A. Stierle, C.E.....*72, *73
Pier, tidal, Egerton's.....*57
Piers, bridge, by W. S. Smith.....20
Pieris japonica.....*345
Piesigaster, a new species of serpent.....*332
Piesse, Dr. G. W. Septimus, Ph.D. Portrait.*366
Pigments, thallium, new.....120
Pigs, large white, English.....*112
Pigs, thoroughbred, value of.....80
Pilaster capitals, designs for.....*249
Pile, chloride of lime, Naudet's.....*219
Pile-driving, hydraulic.....*237
Pile-driving, new system of.....*129
Pile driving, pneumatic, by J. W. Glenn.....141
Pile, electric, dry, Van Tenac's.....58
Pile, medical, miniature, Soares'.....*412
Pile, mercury-bichromate, Fuller's.....*71
Pile, Pezzer-Plante.....*323
Pile, pneumatic, Burns'.....121
Pile, secondary, Reynier-Faure.....*322
Pile, selenium, Mercadier's.....*326
Pile, standard, Reynier's.....*425
Pile, sulphate of copper, new.....*404
Pile, Sir William Thomson's.....*363
Pile, thermo, improved, Ridcut's.....*238
Pile, thermo-electric, Clamond's...*120, *211
Piles and accumulators at the Munich Exhibition of Electricity. Descriptions of several kinds, with numerous engravings illustrating Plante's apparatus and the principal phenomena that have been obtained with it.....*414
Piles, electric, apparatus for testing.....*365
Piles for electric lighting, Reynier-Faure..*342
Piles, secondary, progress made in.....348
Piles (see also Batteries).
Piles, secondary, new, Reynier's.....*426
Piles, testing bell for, Barbier and Pieret's.*341
Piles, wooden, pneumatic system of sinking, by J. W. Glenn.....141
Pilgrim's Progress, new; milestones in his journey from 1620 to 1876.....5
Pill coating, by E. S. Bull.....130
Pills, how to coat with gelatine, by C. W. Holmes. 370
Pills, phosphorus, new method of making...198
Pilocarpin in diphtheria.....314
Pilocarpin in intermittent fever, by Gaspar Griswold, M.D.....201
Pilocarpin, influence of in baldness.....231
Pine-cones, turpentine from, apparatus to distill.....*216
Pine, Kauri—Dammara Australis.....*415
Pine timber, effect of prolonged stress upon the strength and elasticity of, by Prof. R. H. Thurston.....297
Pine, white, in Michigan, natural and industrial history of, by W. H. Ballou.....302
Pine, yellow, strength of.....404
Pipe cutting and threading machine.....*400
Pipe joint, differential-screw, Bourry's....*80
Pipe-jointing, elastic, Roche's.....*25
Pipes, sewer, manholes on, best forms.....*419
Pipe, water, cast iron, requisite thickness of under heavy pressure.....192
Pipe, wrought iron, manufacture of.....*136
Pipes, clay, how made.....361
Pipes, drain, machine for, Whitehead's.....*66
Pipes for gas and other purposes. An excellent practical treatise, with 32 illustrations. The various kinds of pipes—chameroy, wood, paper, cement, and slate pipes; the numerous joints—ball and socket, harness, etc. The destructive power of various soils, and the most successful methods of preserving pipe. Extended directions on main laying, giving best practice..*62, *64, *66, *67, *68, *69, *70, *72, *77, *80, *82
Pipes for plumbing, by T. M. Clark.....121
Pipes, iron, large, how manufactured.....*419
Pipes, metallic, how to bend.....*315
Pipes of all peoples.....*336
Pipes, stone, North American Indian, by C. C. Abbott.....*33
Pipes, water, frozen, apparatus for thawing, Sloan's.....*1
Pirn, winding, improvement in.....*109
Pisciculture in California.....60
Piston-packing, Gifford's.....*19
Piston-packing, metallic, Pinker and Adamson's.....*44
Piston-rods, lathe for turning, Schönheyder's. *22
Piston speed, its influence on the frictional and air resistance of an unloaded steam engine and its connected lines of shafting in a factory or machine shop, by Engineer Isherwood.....238
Pitch Lake of Trinidad.....174, 175, 383
Pitch, number of vibrations necessary to recognize, by Prof. Dolbear.....218
Pitcher-plants and their culture.....*352
Pitcher plants, by Joseph F. James.....390
Pith plant, shola.....167
Pitches for screws with angular threads....127
Pittsburg and her manufactures.....*337
Pitchers and drinking vessels, magic.....*289
Pittsburg, objects of engineer'g interest in...86
Piuru, or Indian yellow, its sources and uses, by T. N. Mukharji.....419
Plagioscope, or centrifugal force appar..*361
Plagues and pestilences, chronology of.....370
Planers, metal, gearing for, Bilgram's.....*396
Planet and satellite, effects on the configuration of, resulting from tidal friction, by G. H. Darwin, F.R.S.....226
Planetarium, a new.....*230
Planetary stability, limit of, by Prof. Daniel Kirkwood.....267
Planets, ultra Neptunian.....256
Planing machine, vertical, improved...*310
Planometers and scraped surfaces, by J. Rose. *15
Plant, a new.....*425
Plant labels, how to make.....279
Plant-feeding, agricultural.....177
Plant portraits, the North collection of, at Kew Gardens, with portrait of the artist, Miss Marianne North.....*347
Plantain as a styptic, by J. W. Colcord.....415
Planting for profit.....298
Plants, absorption of selenium by, by Dr. C. A. Cameron.....184
Plants, absorption of water by.....176
Plants and animals, protective mimicry in..254
Plants and animals, varying susceptibility of to poisons and diseases.....303
Plants, chemical action of, by A. Vogel.....16
Plants, chemistry of.....175
Plants, climbing, movements and habits of, by Ellen Lubbock.....2
Plants, diseases in, caused by bacteria, by Prof. T. J. Burrill.....*297
Plants, economic, in Jamaica.....85
Plants, economic, new, notes on.....325
Plants, effect of uninterrupted sunlight on..220
Plants, evergreen, action of frost upon.—Ornamental gardening, cheap.....284
Plants, fiber, of India, by J. W. Minchin.....407
Plants, growing by electricity.....*242
Plants, gutta-producing of the Malay Peninsula. 152
Plants, house, how to clear of insects.....75
Plants, how they feed, by Dr. Sachs.....35
Plants, how to dry for the herbarium.....347
Plants, influence of electric light on, by P. H. Deherain.....378
Plants, leaves of, absorption of water by....176
Plants, medicinal, cultivation of at Hitchin, England, by E. M. Holmes.....107
Plants, medicinal, cultivation of in Lincolnshire, England, by E. M. Holmes.....304
Plants, microscopic crystals in, by W. K. Higley.....257
Plants, movem'ts of, by Rev. G. Henslow.*297
Plants of New Caledonia.....*21
Plants, physiology and bio-chemistry of, by H. P. Armsby.....269
Plants, restoration of by hot water.....128
Plants, silica taken up by.....*37
Plants, spread of epidemic disease in, by Dr. W. G. Farlow.....410
Plants, the growth of, by W. B. Hemsley.....57
Plants, travels of.....339
Plaster casts, how to bronze.....169
Plaster casts, of fish, how to make.....126
Plaster, remarkable effects of on clover....114
Plastering, wall, drying in three days, method of in Denmark.....98
Plastic compound, new, from cellulose, by Edward Weston.....354
Plate and saucer machine, Faure's.....*162
Plate, boiler, bending rolls, Palmer's.....*302
Plate cleaning, photo.....89
Plate-holders, construction and preservation of.....58
Plate-in-the-bath pictures.....93
Plate-pickling machine, Taylor's.....*75
Plate-press, hydraulic, German.....*417
Plate-rolling, machinery for.....*221
Plates and lenses, cleaning of.....89, 97
Plates, copper, method of steeling.....170
Plates, dry, developing, Roche's method....301
Plates, dry, highly sensitive.....63
Plates, dry, rapid, by H. W. Bevan.....229
Plates, dry, preparation of, by H. Vogel.....29
Plates, dry, solarization of, by Franz Stolze.300
Plates, dry, vs. wet collodion.....190
Plates, how to clean.....352
Plates, metallic, for printing, Michaud's.....184
Plates, porcelain, machine for making.....*29
Plates, sensitive, how to make, by J. A. Forrest. *272
Plates, wet, intensifier for.....388
Plateau's films, a paper describing some interesting experiments with "Plateau's films," a subject of physics almost ignored in text-books. *160
Plating, electro, full details of processes..*310
Platinotype printing, improvem'ts in....155
Platinum and iridium, method of purifying. 194
Platinum and silver, oxidation of, by William Skey.....79
Platinum, coating metals with by Dode's process.....177
Platinum crucibles, how to mend.....142
Platinum, metallurgy of.....141
Platinum pictures.....146
Platinum series of metals, preparation of in a state of purity, and notes upon the manufacture of iridio-platinum, by George Matthey.....183
Pleuro-pneumonia, by Prof. James Law. 213
Pliocene man, by Dr. C. C. Abbott.....208
Plow, snow, Mabbs'.....*46
Plow, steam, windlass tender, Cheneral's..*143
Plow, the primitive, and its immediate successors, from examples at the Paris Exhibition, by E. H. Knight.....*135
Plow, three-furrow, Ransome's.....*59
Plowing by electricity.....*201
Plowing in rye.....32
Plowing, subsoil, will it pay.....139
Plowing-engine, steam.....*199
Plowing-engine, steam, Fowler's.....*304
Plows and plowing. What is good plowing.308
Plows, improved, Fondeur's.....*330
Plows of all nations, by E. H. Knight.....141
Plows, official trial of, at the Paris Exhibition, with illustrations of many novel forms of French and American make, by Edw. H. Knight..*164
Plows, snow, of the Central Pacific R.R.....*8
Plug, safety, fusible, for boilers, Adams'..*335
Plugs, fusible, for boilers.....*410
Plugs, leaky, how to refit to their cocks, by Joshua Rose.....*12
Plumbing, hot and cold water.....*160
Plumbing, pipes for, by T. M. Clark.....121
Plumbing, practical notes on, by P. J. Davies. A paper of great value, not only to the apprentice, but also to the journeyman plumber, giving full details in regard to the best methods of performing the various operations connected with the trade.....*309, *311, *315, *319
Plumbing, useful hints on.....122
Plums, how made into prunes.....90
Pneumatic apparatus, Heron's.....*404
Pneumatic apparatus of London, by R. S. Culley.....2
Pneumatic clock, Bourdon's.....*355
Pneumatic clocks at Vienna, Mayrhofer's...*84
Pneumatic clocks, the Paris system of.....*293
Pneumatic dispatch system in Paris.....*24
Pneumatic foundations.....*218
Pneumatic grain elevator, Benhaye...*133
Pneumatic hammers, Thwaites'.....*396
Pneumatic ore stamps, Scholl's.....*67
Pneumatic pen, new.....*49
Pneumatic postal transmission in Vienna and Berlin.....*90
Pneumatic railway, projected, London..*84
Pneumatic rock boring machinery.....*92
Pneumatic steering apparatus, Baird's...*2
Pneumatic system of sinking piles, by J. W. Glenn.....141
Pneumatic telegraph, Guattari's.....*35
Pneumatic telegraphy.....5
Pneumatic tube for mountain railways.*276
Pneumo-enteritis, or hog cholera, its nature and treatment.....228
Pneumonia, by Prof. Alonzo Clark, M.D. Two valuable and interesting lectures, containing much information not to be found in text books. 219, 220
Pneumonia, heart clot in, clinical lecture by Dr. Alfred L. Loomis.....174
Pneumonia, its characteristics, signs, complications, and treatment, by Prof. Francis Delafield, M.D. A valuable clinical lecture.....377
Poggendorff, Prof. J. C., by W. Flight.....65
Pointed objects seen under microscope....*225
Poison oak of California, by J. G. Steele....95
Poison of serpents.....332
Poisoning by lead, by Dr. Wm. Pepper.....235
Poisoning by strychnine, treatment by chloral hydrate, apomorphia, and electricity, by C. M. Worthington, M.D.....193
Poisons in the household.....283
Poisons, our domestic, by Henry Carr, C.E. A paper calling attention to certain poisonous materials that are heedlessly introduced into or intentionally used in our fabrics.....219, 220
Poisons, the division of, by W. E. Bibby.....19
Polar regions, geology of.....129
Polarimeter, new, Laurent's.....*374
Polariscope as applied to sugar manufacturing and brewing, by J. Steiner. A lucid exposition of the principles which underlie the construction of the polariscope, and an explanation of the laws which permit its application for the determination of different sugars.....*201, *202
Polishing and grinding, by J. Rose...*31, *34
Polishing and grinding machine, stone, Salmon and Crossland's.....*261
Polishing machine for telescope reflectors, Grubbs'.....*44
Polishing powder for gold articles, recipe for. 144
Poly-microscope, Von Lenhossek's.....*143
Pollen grains as seen under the microscope, by W. G. Smith.....*62
Pompeii, new discoveries at.....58
Pompeii, recent visit to, by H. D. Garrison.180
Pompeii, victims of, recent excavations of.375
Pompeii, wall-paintings of.....65
Pompelian house, a.....239
Pompanoes, characteristics, occurrence, and food value of, by G. Browne Goode.....349
Pond, artificial, how to make.....*240
Ponds for trout, how to make.....*246
Pontoon bridge, Berthon's collapsible boat for. *199
Pontoon dry dock, floating, Turnbull's.*275
Poplar tree.....336
Popocatapetl, ascent of in 1833.....389
Population of the United States in 1776 and in 1886.....33
Porcelain, gilding and plating on, process.. 86
Porcelain, history, manufacture, and decoration of, by Chas. Louth.....335
Porcelain, how manufactured.....347
Porcelain, manufact. of, by J. W. Mallet...232
Porcelain, process of decorating with gold.164
Porcelain photography, by J. R. Sawyer.256
Porcelain painting, how to prepare the colors for, by V. Joclet.....170, 182
Porcelain plates, mach. for making, Faure's. *29
Porcelain printing.....144
Pork and bacon, American, how prepared for commerce.....236
Port Henry, geology of, by T. S. Hunt.....195
Port of Colon, new dredge-boat for.....*431
Port of Dunkirk, France, new docks at.*262
Portage Viaduct, new.....*4
Portland cement, results of tests as to its resistance to crushing.....90
Portrait and frame work, how to obtain at one printing.....17
Portraits in watch glasses, how to take.....77
Portraiture, Mr. Liebert on.....149
Port wine mark, method of removing, Dr. Squire's.....223
Port wine marks on the face, treatment of, by Dr. B. Squire.....56
Positives, direct, for enlarging.....60
Positives in the camera, meth. of obtaining.255
Post Office and Custom House, Albany, N. Y., *84, *85
Post Office, British, operations of.....302
Post Office building, Minneapolis.....*420
Post Office, Peoria.....*411
Postage stamps, improvement in, by P. H. Van der Weyde.....49
Postal transmission, pneumatic, in Vienna and Berlin.....*90
Posts and shores.....*94
Potash, chlorate of, and binoxide of manganese, accidents from in making oxygen gas.....330
Potash, chlorate, toxic properties of.....326
Potassa, new process for the estimation of, by A. Carnot.....45
Potassium carbonate, manufacture of by the direct treatment of the chloride with trimethylamine.....326
Potassium, determination of, by L. L. De Koninck.....306
Potassium, neutral oxalate of, how to prepare. 296
Potato beetle, how to destroy.....248
Potato beetles, apparatus for destroying, Badona's.....*4
Potato-beetles, machine for destroying, Iske's. *28
Potato-bug, medical properties of.....369
Potato culture contest, novel.....201
Potato culture, hints on.....85
Potato growing, extraordinary.....7
Potato, sweet, composition and nutritive value of.....71
Potatoes and their utilization. How to make starch, gum dextrine, glucose, whisky, and vinegar from potatoes. Desiccated potatoes.—Imitation of alabaster from potatoes.....*313
Potatoes, cost of raising.....105
Potatoes, how to produce early crops of....378
Potatoes, level culture of.....32
Potatoes, rotting, prevention.....206
Potatoes, test of the relative merits of.....53
Potential energy, by S. T. Preston.....87
Pottery, American, ancient.....*261, *282
Pottery, ancient, found in Missouri mounds, by A. J. Conant.....151
Pottery and porcelain industries of Japan..303
Pottery, how to enamel.....387
Pottery interest, American, by J. A. Norton.201
Pottery, Lucca della Robbia, in New York Museum of Art.....374
Pottery, prehistoric, Terry collection of....223
Poultry and egg trade of Europe and the United States.....373
Poultry cholera, a governm't paper on, giving valuable rules for its prevention and cure..298
Poultry farming, notes on, and illustrations of some remarkable kinds of poultry raised in Germany.....*306
Poultry, fattening of by machinery.....*103
Poultry raising, profits of.....397
Poultry, standard requisites for.....200
Power, can it be transmitted in large amount by electricity? By N. S. Keith.....87
Power, horse, home-made.....*190
Power, motive, transmission of, data respecting various methods.....68
Power presses, Bliss and Williams'.....*35
Power, storage of, by Prof. W. E. Ayrton. An instructive review of the conditions under which power can be stored economically.....*338
Power, transmission of.....259
Power, transmission of to a distance.....188
Power, transmission of. A summary, by Arthur Achard, of the practical results obtained in the transmission of power to a distance by different modes.....274, 275
Prairie roads and streets, improvement of, by B. T. J. Nicholl.....*151
Prairies, treeless, of the West, by Thomas Meehan.....298
Praxinoscope, theater, a new scientific toy. *224
Precipitates in chemical analysis, new method of separating and treating, by F. A. Gooch.*130
Precipitates, washing, automatic apparatus for. *292
Presbyopy, or long sight, treatment of....*136
Prescriptions and formulæ for a large number of new preparations.....75
Preserves, jellies, and jams. A valuable collection of household recipes.....196
Preserving-fluid, Wickersheim's....292, 318
Press, cloth, hydraulic.....*426
Press, continuous, beet pulp, Dujardin's...*351
Press, continuous, for sugar works and distilleries, Dujardin's.....*375
Press, continuous, for woolen cloth, Harwood and Quincy's.....*146
Press, cotton, hydraulic.....*114
Press, daily, of 1880.....331

Press, filter, Foakes'.....*391
Press, filter, for treating oleaginous seeds..*358
Press, hay, Pilter's.....*371
Press, hydraulic, Brinck and Huber's.....*387
Press, hydraulic, by Prof. Perry.....*366
Press, hydraulic, for iron plate.....*417
Press, power, elastic bed, improved.....*263
Press, steel band, Von Grass-Klanin's.....*337
Presses for cheese, English.....*155
Presses, power, Bliss and Williams'.....*35
Presses, wine, French. Descriptions of many kinds.....*154
Pressing fabrics, hot, apparatus for.....*224
Pressing machine for bran, etc., imp'd...*394
Pressing machine for cloths, Gessner's.....*344
Pressure and blows, relative value of, experiments on by Prof. Kick.....56
Pressure and suction appar. Muencke's...*310
Pressure apparatus for drawing beer...*346
Pressure-gauge, Bourdon's.....*70
Pressure-gauge, gas, new.....*76
Pressure, high, in liquids, apparatus for measuring.....*337
Pressure-regulator for water-conduits, Eichenauer's.....*372
Pressure-regulator, steam, D'Arsonval's. *277
Prestidigitation, the induction balance applied to.....*289
Prickly heat, remedy for.....81
Prime movers, by F. J. Bramwell, C.E.....30
Priming in steam boilers, by W. Major.....*82
Print washing machine, self-acting, by W. A. Nichols.....*97
Printing and folding press, Duncan and Wilson's.....*76
Printing and transferring designs, process..180
Printing and writing materials, recent improvements in, by J. W. Mallet.....287
Printing by the blue process, apparatus for, by Channing Whitaker.....*365
Printing, carbon, improvements in.....103
Printing, direct, from glass negatives.....118
Printing, dyeing, and bleaching, by M. De Vinant.....53
Printing fabrics, recipes for colors.....208
Printing, fatty ink, from gelatine, improvement in, by L. Vidal.....31
Printing ink, indelible, recipe for.....21
Printing machinery cloth, Godfrey's.....*360
Printing in water colors, by J. Husnik.....64
Printing on glass, Koeppe's method.....176
Printing on glass, method of.....*47
Printing on woolen, recipe for.....226
Printing ornamental borders to carbon pictures. 1
Printing, photographic, processes.....351
Printing, photo-lithographic.....257
Printing, pigment, permanent, in photography. 144
Printing plates, heliotypic, how to make..205
Printing plates, music, new method of preparing.....89
Printing press, copper plate, Marcilly's..*408
Printing press, cylinder, Derriey's.....*165
Printing press, Daughaday's.....*34
Printing press, Degener and Weiler's.....*33
Printing press, double, Hoe's.....*46
Printing press, fast, for engravings.....*417
Printing press, Kidder's.....*308
Printing press, Liberty.....*33
Printing press, multicolor, new.....*242
Printing press, rotary, for illustrated papers, Alauzet's.....*156
Printing press, two-color, Alauzet's.....*277
Printing press, Victory.....*76
Printing press, zincographic.....*290
Printing presses, taking-off apparatus, Smith's. *263
Printing processes, autographic, modern, description of several, such as the lithographic, the electro-chemical, the papyrograph, electrical pen, Zuccato's method, collography, blue process.....225
Printing processes, by C. Baumann.....82
Printing processes, photographic, in the service of the Portuguese government.....123
Printing processes, Woodbury.....213
Printing receipes for fabrics.....208
Printing, silver, permanent.....406
Printing surfaces and pictures by photography, by Thomas Bolas.....143, 146
Printing woolen, colors for, recipes.....64
Printings, photographic, by J. L. Gihon.....144
Prints, blue, large, how to make.....421
Prints, blue, on paper, wood, etc., by T. C. Roche.....61
Prints, how to mount without distorting...423
Prints, faded, treatment of for copying.....248
Prints, fireproof, how to make.....311
Prints, photochromic, process for, by Leon Vidal.....35
Prints, photographic and other, how to render transparent, by E. W. Poston.....297
Prints, photographic, how to enamel.....67
Prism, how Newton inquired into the meaning of colors with.....85
Prism with wide-angled aplanatics.....*234
Prismatic instrument, novel, for lighting up the dark cavities of the body.....*210
Prison, Auburn.....248
Prizes, awards of at Paris Exhibition, list of. 149, 150
Probe and extractor, electric, Trouvé's.....*29
Proofs, over-printed, reduction of.....293
Projectile-velocimeter, Sebert's.....*177
Projectiles and armored targets, recent trials of in England.....*148
Projectiles, apparatus for measuring and registering the laws of motion of.....*254
Projectiles, manufacture of, by J. Davidson. *310
Propagating box, how to make.....*330
Propeller, adjustable, Bevis'.....*93
Propeller and propeller shaft of the steamer Thetis.....*81
Propeller, De Bay's.....*250
Propeller, De Bay, performance of.....270
Propeller engine, novel, by Prof. C. W. MacCord.....*415
Propeller, feathering, Welton's.....*338
Propeller for velocipedes and sleighs.....*159
Propeller, new, Rankin's.....*29
Propeller patterns, Osten's method of making. *92
Propeller, screw, assistant, McKenzie's...*200
Propeller, screw, Crooke and Mylchreest.*278
Propeller, screw, De Bay's; also apparatus for testing screw propellers.....*170
Propeller, screw, Collis Browne's.....*27
Propeller, screw, Eyre's.....*74
Propeller, screw, improved, by J. E. Wilson. *1
Propeller, screw, Mallory.....*145
Propeller, screw, Thornycroft's.....*77
Propeller screws, cause of vibration in...349
Propeller screws, mechanism for raising and lowering, Brooks'.....*20
Propeller steamship and double rudder, by Capt. Sadler.....121
Propeller, twin screw, engine for, Whiting. *9
Propeller wheels, the work of, by H. C. Pearsons.....*278
Propellers, arrangement of, and form of stern in screw ships, in order to obtain the best effect in propulsion, by R. Griffiths.....181
Propellers for war ships, new combination of, by George Quick, R.N.....12
Propellers, screw, action of, by J. Howden.*101
Propellers, screw, efficiency of.....*208
Propellers, screw, experiments on the position of.....*272
Propellers, screw, (see also Screw Propellers).
Propellers, screw, Spartall's.....*16
Propulsion, hydraulic, new system of...*354
Propulsion, marine, possible improvem't in. 69
Propulsion, marine, theory of, recent investigations on.....12
Protoplasm, a speculation on, by Persifor Frazer, Jr.....187
Protoplasm, by Dr. G. J. Allman.....195, 196
Protoplasm, structure of.....*87
Protozoa, flagellate, by W. Saville Kent..*126
Prunes, how made.....90
Pruning fruit trees, method of.....*109
Prussian blue, manufacture of from spent oxide of iron.....79
Pseudo ceramics; how to make vases of pasteboard in imitation of decorated pottery; cylinder vases, with ornaments in high relief; elliptical vases; triangular and square vases; how to shape the pasteboard; how to make the joints; how to prepare for painting, and how to paint them.....*317
Psychical Research Society, Reichenbach and. 394
Psycho, improved.....*106
Psychological development in children, by George J. Romanes.....358
Psychology and the baby; development of mind in the infant.....257
Ptomaines, the recent investigations of Brouardel and Boutmy on.....264
Public buildings, Philadelphia.....*33
Public buildings, ventilation of.....*250
Public institutions, unhealthiness of, by H. C. Burdett.....256
Puddler's balls, squeezing machine for...*78
Puddling furnace, Abbott's.....*140
Puddling furnace, Casson-Dormoy.....*25
Puddling furnace, patent retort, Price's, at Woolwich arsenal.....*108
Puddling iron by machinery, by R. Howson. 70
Puddling iron, coal required for.....76
Pulley-block, self-stopping, Wilke and Lappe's. *20
Pulley, expansible, Schulte's.....*308
Pulleys and gear, transmitting, for variable velocities, Sertori's.....*359
Pulleys and other rotating parts of machinery, how to balance.....*221
Pulleys and pinions for millstone spindles, by Charles B. Coon.....210
Pulleys, how to balance.....*368
Pullman, city of.....429
Pullman sewerage, by B. Williams.....*351
Pulp, paper, black, recipes for.....249
Pulp, paper, machine for, Lebrousse.....*170
Pulp, wood, apparatus, Dresel's.....*299
Pulsator, Bretonnière's.....*277
Pulse, the. A clinical lecture, by T. A. McBride, M.D., of great value to medical students.....235
Pulsometer, Hall's.....*115
Pulverizing machine, Jordan's.....*262
Pulverizing mill, Hauctin's.....*61
Pump, air, condensor, Tangye's.....*109
Pump, air, mercurial, how to make, by G. M. Hopkins.....*224
Pump, air, mercurial, Neeson's.....*289
Pump, air, Niagara duplex.....*32
Pump, air, Sprengel, an improvement on, by Prof. O. N. Rood.....*240
Pump, air, Sprengel, Rood's modification..*303
Pump, air, Wylie's.....*33
Pump, centrifugal, and steam engine, Lawrence and Porter's.....*22
Pump, centrifugal, and 3-cylinder engine, Brotherwood's.....*34
Pump, centrifugal, for ships, Allen's.....*333
Pump, feed water, Gauchot's.....*407
Pump, fire, and steam engine combined...*408
Pump, fire-engine, improved.....*120
Pump, gas-tar, improved.....*89
Pump gearing, Leamington Water Works..*206
Pump, horse-power, simple, how to make...*38
Pump, injection, Laurent and Collot's.....*358
Pump, mining, Blake's.....*63
Pump, mining, improved, Silver's.....*23
Pump, pendulum, Stannah's.....*104
Pump, rotary, Doremus'.....*19
Pump, sand, Clift's.....*357
Pump, steam, differential, Davey's.....*149
Pump, steam, double-acting, Ashworth's...*34
Pump, steam, improved.....*87
Pump, steam, Norwalk.....*31
Pump, steam, pulsating.....*277
Pump, steam, rotary, Bartrum and Powell's. *149
Pump, steam, Syers'.....*49
Pump, vacuum, and steam engine combined, Gleason's.....*31
Pump, vacuum, Sprengel, application of in filling barometer tubes, by E. Francis.....*19
Pumping engine, Corliss, for Pawtucket, R. I. *183
Pumping engine, Cornish, for Hull (Eng.) Water Works.....*17, *23
Pumping engine, direct acting, Mathieson's.*11
Pumping engines for the Ferrara Marshes, Northern Italy.....*9
Pumping engine of the Lehigh Zinc Works, at Friedensville, Pa.....*32
Pumping engine, Pearn and Co.'s.....*67
Pumping engine, steam, direct acting, compound, Tangye's.....*41
Pumping engine, steam, Rumble's.....*154
Pumping engine, underground, improved..*78
Pumping engine, Walker's.....*19
Pumping engine, Worthington's.....*56
Pumping engines for city water supply and fire protection, Holly system of.....*140
Pumping engines for Newent Collieries..*219
Pumping engines of Covington, Ky., Water Works.....4
Pumping engines of S.S. Gallia.....*212
Pumping engines of the Lawrence, Mass., Water Works.....*66
Pumping machine for forcing gas directly into the mains; a new system of supplying gas direct to the consumer.....*231
Pumping station, Boston.....*378
Pumps, compound, Worthington's.....*289
Pumps, horse power, Nives'.....*424
Pumps, oscillating motor for.....*376
Pumps, primer for, Normand's.....*379
Pumps, regulator for air-chambers of.....*283
Pumps, rotary, improved, Crocker's.....*12
Pumps, steam, antique and modern.....*115
Pumps, three-throw, Hayward and Tyler..*105
Punch, concentric, for cutting out washers, Schwab's.....*323
Punch, spiral, Kennedy's *125
Punching and shearing machine, quadruple, hydraulic, Chapman's.....*75
Punching and shearing machine, Berry and Son's.....*59
Punching Press, Merriman's.....*34
Purifier and feed-water heater, Strong's..*363
Purifier, condenso, for gas, Chevalet's.....*363
Purifier, gas, Pelouze's.....*234
Purifier, gas, Still's.....*58
Purifier, middlings, Excelsior.....*185
Purifier, middlings, electrical, Osborne's..*235
Purifier, middlings, Paragon.....*28
Purifier, smoke, Johnson and Hobbs'.....*223
Purifiers, middlings, various systems of..*101
Purple, London, as an insecticide.....218
Pustule, malignant, how to treat, by Dr. C. A. Leale.....287
Put-log fastener, for temporary bridges, Boullant's.....*239
Puzzle, bail, at Centennial.....*47
Puzzle, the square.....*21
Pyorrhea alveolaris, diagnosis and treatment of, by Dr. J. M. Riggs.....358
Pyramid, the great, ascent of.....*229
Pyramid builders, tools of.....*398
Pyramid builders, tools of.....*398
Pyramid, great, and theories concerning it, by Prof. H. L. Smith.....419
Pyramid of Meydoom.....*321
Pyramid, the great, by R. A. Proctor.....*332
Pyramids, Egyptian.....*268
Pyrethrum, cultivation of and manufacture of insect powder from.....299
Pyrethrum the best insect killer.....247
Pyrheliometer, the.....*218
Pyrogallic acid, dangers of, by Dr. T. L. Phipson.....312
Pyro-gallol for dry-plate development.....270
Pyrometer, Fischer's.....*198
Pyrometer, new, Main's.....*33
Pyrometer, Seyfferth's.....*288
Pyrometer, water, platinum, Hoadley's..*358
Pyrometers, Zobel's.....*172
Pyrometric instruments, new.....256
Pyrophone, or flame organ, Kastner's.....*357
Pyrotechny, colored fires for, recipes.....49
Pyroxyline, composition of, and the formula of cellulose.....237
Pyroxyline, new solvent for.....183
Pythons, caged, experiments with, by Lieut. T. Hutton.....333

Q

Quadrangle of Muir College, Allahabad, India.....*111
Quadrature of the circle.....*282
Quadrupeds, British, ancient and extinct, by Dr. A. Leith Adams. A highly interesting and valuable paper.....72, 73, 74
Quarries, freestone, N. S. Wales.....*427
Quarries, slate, applic. of electric light in.*271
Quarries, slate, of Monson, Me.....177
Quartz crushing machinery, by John Richards. 319
Quartz crystals, explosion of.....371
Quartz ledges, the Cariboo.....*113
Quassiin, by A. Christensen.....354
Quick matches, how to make.....209
Quicksand, boring through at Minnie Pit..426
Quicksands, mode of making solid foundations on.....*237
Quicksilver and sulphur deposits, and the borax lake of California.....38
Quicksilver mine, Guadalupe.....81
Quicksilver mines of California, geology of, by Luther Wagoner, C.E.....375
Quicksilver ores, how treated in Spain...312
Quicksilver pump in the silver mill.....*155
Quillaia saponaria, saponine from; also tincture of quillaia as an emulsifying agent, by H. Collier.....200
Quills, modern uses of.....8
Quinces, culture of.....181, 349
Quinces, some facts concerning.....139
Quincy methods in education, by B. G. Northrop.....268
Quinine and salicylic acid, action of on ear..333
Quinine group, application of polarizer to examination of, by H. A. Mott.....129
Quinine in sunstroke.....29
Quinine, milk as a solvent of.....140
Quinine, preparation for hypodermic use..271
Quiniodine, borate of, as a febrifuge.....308

R

Rabies, a possible cause and a probable preventive of, by S. L. Dorr, M.D.....310
Rabies in dogs, its origin and symptoms; with hints on treatm't of bites of mad dogs.....114
Racing, boat, laws of.....2
Radiant energy, production of sound by, by Prof. Bell.....*281
Radiant matter spectroscopy; a new method of spectrum analysis, by William Crookes..394
Radiating machine, steam, Hercules, for the St. Heller's harbor works.....*80
Radiation, mechanical action of, by Le Roy C. Cooley, Ph.D.....17
Radiation, repulsion resulting from; experiments on the repulsion produced by the different rays of the solar spectrum, by W. Crookes...22
Radiation, terrestrial, by John Tyndall...382
Radio-dynamics, by P. E. Chase.....294
Radiograph, or sunshine recorder, Winstanley's.....*277
Radiograph, Winstanley's.....*256
Radiometer, by Prof. C. A. Young.....69
Radiometer, by Sir Wm. Grove.....69
Radiometer, is it an electric engine?.....*44
Radiometer, researches on, by Prof. P. Volpicelli.....57
Radiometer, theories of.....*13
Radiometer, what causes it to revolve?.....37
Radiometers, by Dr. Andrews, F.R.S.....26
Radiometric experiments, in Germany.....31
Radius, fracture of, treatment by Dr. R. J. Levis.....*230
Rafts, life-saving.....*198
Rag works at Ghent, Belgium.....161
Rags, woolen and cotton, apparatus for separating.....*378
Rail and road truck wheels, combined.....*302
Rail and track joint, standard.....*395
Rail and wheel for common roads.....*377
Rail mill engines, Davey's.....*391
Rail mill, vertical engine for.....*232
Rail joint, Acaster's.....*125
Railing, iron, ornamental.....*383
Railing, iron, ornamental, design for.....*57
Railing, ornam. for Goethe monument.....*287
Railroad, Boston, train dispatching on.....332
Railroad, two-foot gauge, Billerica and Bedford. *115
Railroad car, first class passenger, detailed cost of.....263
Railroad coaches, lighting by electric'y.*406
Railroad, Denver and Rio Grande, scenery on the Utah line of.....401
Railroad, elevated, New York City.....*122
Railroad hand-car, Romans'.....*173
Railroad, Hudson River, depots of.....253
Railroad in the clouds; interesting description of the Callao, Lima, and Oroya Railroad, and of the country through which it passes, by J. E. Montgomery.....83, 84
Railroad, interoceanic, Tehuantepec, progress of.....295
Railroad law, progress in New York.....231
Railroad locomotives (see Locomotives).
Railroad, New Orleans and Texas.....248
Railroad, New York, West Shore, and Buffalo, New York terminus of opposite 42d Street.*381
Railroad, Northern Pacific.....412
Railroad, Pennsylvania, stockyard of.....*87
Railroad, Pennsyl. terminal facilities of.....260
Railroad, Rigi; brief description, with view of Mt. Rigi, showing the line of the road.....*245
Railroad rolling stock, American, features of.....203
Railroad shakes. Suggestions on the proper trimming up of trucks to give them easy riding qualities, by S. W. Robinson.....218
Railroad, ship, the Isthmus, proposed, by J. M. Goodwin.....*196
Railroad shops of N.Y., N. H., and H. R.R.. 5
Railroad signals; descriptions of the principal kinds now used.....226
Railroad, single-rail, Stone's, at Centen....*33
Railroad, Southern Pacific.....42
Railroad station, an English.....*318
Railroad, ten-inch gauge, Massachusetts..105
Railroad through the Sahara, preliminary labors for.....258
Railroad time-tables, how arranged.....320
Railroad track sweeper, Olmstead's.....*97
Railroad travel, summer, discomforts of..241
Railroads and locomotives, American, an interesting history of from 1826 up to the present, by F. C. Smith.....*371
Railroads, gravity, of N. Y., L. E., and W. R.R. Co.....189
Railroads of the U. S., Jan. 1, 1876.....5
Railroads of the world, lengths of, by Dr. G. Stuermer.....27
Railroads, street, new steam car for.....*422
Rails and tires, diminution of friction between, by D. McDowell.....*11
Rails, Bessemer steel, manufacture of, by C. B. Holland.....*124
Rails, curious wear of.....*300
Rails, expansion of.....350
Rails, jackscrew for raising.....*265
Rails, machine for straightening.....*53
Rails, steel, and Bessemer steel, manufacture of, by C. B. Holland.....*124
Rails, steel and iron, comparative wear of..25
Rails, steel, English, experience with.....33
Rails, steel, of various makes, comparative wear of.....192
Rails, wear and tear of, apparatus to measure, Kraft's.....*251
Railway accident at Morpeth, Eng.....*73
Railway accid't, remarkable, Hugstetten.*366
Railway accident, remarkable, on the Chicago and Northwestern Railroad.....*40
Railway accident, remarkable, near Ashtabula, Ohio.....*57
Railway apparatus, electric.....*315
Railway appliances at Philadelphia Ex.....125
Railway appliances, French.....*176
Railway, Atlantic and Pacific.....432
Railway axle-boxes, improved.....*117
Railway axles, breakage of, data concerning, by W. Thamm.....76
Railway axles, friction of, experiments on..191
Railway brake (see Brake).
Railway, cable, at Giessbach, Sweden.....*402
Railway, Canada Pacific.....251, 304
Railway car axle, Miltimore's.....*277
Railway car axles, tests of.....*113
Railway car, compressed air.....*18
Railway car construct'n, past and present..203
Railway car couplings, English. A very comprehensive paper, containing descriptions and illustrations of all the leading types of car couplers used in English railway practice.....*21
Railway car derrick, Vorug's.....*125
Railway car, dynamometric, French.....*369
Railway car, run by accumulators.....*408
Railway car, refrigerating.....*89
Railway car, refrigerating, Winant's.....18
Railway car, spring-propelled, Leveaux's..*47
Railway car, spring-propelled, Steel and Austen's.....*46
Railway car springs at the Centennial.....30
Railway car, street, steam, Brunner's.....*22
Railway car, street, Muir's.....*38
Railway car-wheels, chilled cast-iron, method of making.....31
Railway car-wheels, foreign, at the Centen. 29
Railway car wheels, improved, Paige's.....*1
Railway cars, steel.....*38
Railway cars, costs of.....204
Railway cars, freight, Eng. and American..429
Railway cars, freight, of N. Y. C. R.R.....*18
Railway cars, iron.....57
Railway cars, safety device for, Root's.....*9
Railway construction, a novelty in; the Darjeeling tramway.....302
Railway crane, locomotive, Dubs'.....*84
Railway line, now, between New York and Canada.....1
Railway, Denver and Rio Grande.....*281
Railway depot, Union, Cincinnati.....*306
Railway, electric, at Brighton.....409
Railway, electric, run by accumulators..*342
Railway, electric, at Paris, Siemens'.....*306
Railway, Egyptian, armored train on.....*351
Railway, electric, Ayrton and Perry's.....*335
Railway, electric, Binko.....352
Railway, electric, coal mine.....*278
Railway, electric, Edison's.....336
Railway, electric, Kew.....*382
Railway, electric, Portrush, Ireland, by Dr. Edward Hopkinson.....388
Railway, electric, Siemens'.....*242
Railway, electric, at Zankerode Mines.....*417
Railway, electric, Siemens-Halske, near Berlin.....*292
Railway, elevated, Berlin, by Wm. Bird..*338
Railway, elevated, in 1836.....254
Railway, elevated, in New York, what it does for street architecture.....139
Railway, endless rail, Ader's.....*211
Railway, field, for rapid construction in wartime, by J. B. Fell, C.E.....55
Railway gauge, changing a, by A. Mordecai, C.E. An interesting account of the change, in less than a day, of 224½ miles of track from a broad to a narrow gauge on the N. Y., Penn., and Ohio R.R.....244
Railway, inclined, Cincinnati.....*120
Railway in China, first, opening of.....*45
Railway, Madrid and Corunna.....*409
Railway mail-bag catcher, French.....*53
Railway, marine, new.....*200
Railway, new, across American continent..127
Railway, new, up Mt. Vesuvius. General description, with map showing route, mountain and surrounding country, and with illustrations of the cars employed.....*235, *236
Railway, Northern, of France, Paris terminus of, with figures showing elevation, plan, and full details of construction.....*40
Railway or ship canal? Remarks of Capt. Eads before the House Committee.....221
Railway passengers, rights of at stations.262
Railway, Philadelphia and Long Branch, by C. S. D'Invilliers, C.E.....350
Railway, pneumatic, projected, London...*84
Railway, rack, locomotive for.....*70
Railway resistance, dynagraph experim'ts.11
Railway resistances, investigations on in England.....34
Railway, Rhenish, the Bottrop Cut of the Duisburg and Quackenbruck Section.....*276
Railway, ship, Eads', for the Isthmus.....*405
Railway, ship, Eads', terms of the Mexican concession.....270
Railway, ship, Tehuantepec, by Capt. J. B. Eads.....305
Railway, ship, Tehuantepec, proposed, by Chas. W. Zaremba.....273
Railway signal, explosive, Aird's.....*13
Railway signal-wire compensator, Lyle's.*286
Railway signals, audible, Brown's.....41
Railway signals, electric, German.....*361
Railway signals, electrical, Siemens and Halske's.....*65
Railway, single rail, for South Africa....*141
Railway, single rail, Lartigue's.....*420
Railway, single rail, impr'd car for, James'.*44
Railway sleepers, iron, Greave's, Griffin's, and Livesey's.....*206
Railway sleepers, iron, Webb's.....*269
Railway sleepers of toughened glass, by C. Wood, C.E.....*207
Railway, specifications for. An important engineering paper, being a full copy of a recent, carefully drawn contract made by a construction company for building a certain portion of a new railway.....402
Railway speeds, English.....282
Railway speeds, high, by W. B. Le Van.....240
Railway, St. Gothard, rolling stock of, by R. Abt.....351
Railway station, mode of lifting as practiced in England.....105
Railway station, passenger, at Washington, D. C.....*71
Railway station roofs, Handyside & Co.'s..*58
Railway stations, new, Melbourne.....*425
Railway, street, the Edge system of.....*220
Railway, suspension, Stevenson's.....*183
Railway swing bridge, Hull and Barnsley's system.....*429
Railway system, modern; how train schedules are arranged and time tables made.....29
Railway ties and sleepers, iron, by Charles Wood.....125
Railway ties impregnated with chemicals, relative durability of.....72
Railway time, fast; across the continent in three days and a half.....28
Railway tires, fracture of.....58
Railway tracks, removal of snow from, devices for.....*46
Railway train velocimeter, Westinghouse's. *64
Railway trains, apparatus to measure speed of.....*372
Railway trains, English, average speed.....421
Railway trains, applica. of electricity to..*345
Railway trains, new battery lights for.....417
Railway truck, 42-inch wheel.....*82
Railway tunnels, ventilation of, by Gabriel Jas. Morrison, C.E.....11

Railway turn-table of the time of Louis XIV. *286

Railway, underground, London, extension of. *53, *56

Railway velocipepe, Sheffield's *178

Railway, Vesuvius, cars of *235

Railway, water power, on the Giessbach 264

Railway wheel, steel, Miltimore's *405

Railway, wire, for coal mines, etc *65

Railway, wire rope, Righi Vaudois *426

Railway works, Crewe, a visit to 341

Railway, 15-inch, Haywood's; object of the road; mode of constructing the line; descriptions and illustrations of the locomotive and cars; and notes upon light railways *296

Railways, American, by O. Chanute 254

Railways, American early, historic notes 402

Railways, cable, Chicago *367

Railways, cable, of Chicago, difficulties and objections to use of in crowded cities 429

Railways, Continental 77

Railways, English. An interesting account of the manner in which railways are operated in England, where the practice differs widely from that in use in America 239

Railways, electric, and transmission of power by electricity. A lecture by Alexander Siemens, in which it is shown that, as a system of transmitting power to a distance, there is a sphere for electricity where it meets existing demands better than our present means 306

Railways, electric, application of turbines to dynamos of *427

Railways, electric, night signal for *301

Railways, electric, Perry and Ayrton's *332

Railways, English, observation on; the great shops at Crewe 304

Railways, mountain, comparative altitudes of. *395

Railways, mountain, pneumatic elevator for. *276

Railways of the world, total lengths of 148

Railways of Peru, wonderful, by Dr. E. R. Heath. An interesting paper 165, 166

Railways, rack-rail, progress of *83

Railways, sinking of in bogs 239

Railways, street, electric, new system of, Smith's *411

Railways, street, locomotive for *73

Railways, street, the cable system of *367

Railways, street, wire-rope, of San Francisco, Cal., by A. S. Hallidie, M.E. Description of a system now in successful operation in San Francisco, which is specially adapted for use where steam locomotives are not permitted, or where the streets are so steep as to make the use of horses difficult or impossible; with thirteen illustrations *298

Railways, Swiss, brief descriptions of the principal 409

Railways, underground, of London 113

Railways, water, novel, St. Malo, France *48

Rain and snow gauge, record'g, Draper *209

Rain, production of by human agency 67

Rain, temperature, apparat. to determine *173

Rainbow rings about the moon *419

Raindrops and hailstones, formation of. Abstract of a paper by Prof. O. Reynolds *65

Raindrops, hailstones, and snowflakes, by Prof. Osborne Reynolds 306

Raindrops, hailstones, and snowflakes, how formed 118

Rain-gauge, simple, how to make *419

Rain-gauges at Rothamsted agricultural station *101

Raisins, California, preparation of 232

Raisins, Malaga, how prepared 333

Rake, horse, the Universal *191

Ram, the hydraulic; the earliest and the latest forms explained *111

Ram, Montgolfier, by W. Jones *155

Ram, torpedo, Polyphemus *255

Ramie fiber, characteristics and uses of 93

Ramie plant, cultivation of 319

Range-finder, Berdan's *175

Range-finder, electric 56

Range-finder, improved, Watkin's *98

Range-finder, Weldon's *223

Rankine, Prof. W. J. Macquorn. Biographical sketch of, with portrait *103

Rapid breathing as a pain obtunder. A paper by Dr. W. G. A. Bonwill, giving an account of his discovery that, by causing his patients to breathe rapidly for a few minutes, pain was so obtunded that their teeth could be extracted without discomfort to them 275

Raphael's tomb and skeleton in the Pantheon at Rome *385

Rare animals in the Zoological Garden, London: Musk deer, Japanese wolf, and unbrette *264

Rashes produced by drugs in daily use 176

Raspberry, culture of 192

Rat king, or rats with entangled tails *234

Ratchet-brace support, King's *11

Rats, how to get rid of 293

Rats, non-poisonous exterminator for 210

Rattlesnake bite, cure for, by J. J. Knott 87

Rattlesnake bite, cure of 271

Rattlesnake poison, antidote for, by Henry H. Croft 360

Rawlinson, Sir Robert, biographical sketch of, with portrait *406

Ray, solar, chemical intensity of; a new method of measuring *173

Reading and speaking, by A. J. D'Orsey 364

Reagents, chemical, by M. W. Iles 98

Reagents, chemical, notes on 296

Realities vs. appearances in photography 116

Reaming machine, self-stopping, Rosseter's. *122

Reaping machine and locomotive combined, Aveling and Porter's *36

Reaping machine, the invention of 125

Reapers and mowers, a classification of, by A. L. Kennedy, M.D *184

Reapers, cutting apparatus for *136

Reapers, dynamometric tests of at Leamington, Eng.: with a table giving many valuable particulars of interest to machinists and to makers and users of this class of apparatus 43

Receiver and cupola, Stewart's *431

Recharger and electrostatic machine, Humblot's *329

Recipes, household and other, by J. W. Parkinson; including recipes for plum pudding, plum pudding sauce, national plum pudding and sauce for the same; egg nog, egg flip, roast turkey, woodcocks and snipe, canvas-back ducks, pheasants, wild ducks, wild fowl sauce, brown fricassees of rabbits, orange pudding, venison pastry, Christmas red round, plum porridge for Christmas festivals, sugared pears, table beer, mince meat, pumpkin pie, brandy punch, bœuf a la mode, punch jelly, orange salad 315

Recipes household, for blackberry wine, currant wine, ginger pop, and for removing ink stains from carpets 89

Recipes, household, 100 choice. A valuable collection of well selected, practical, and economical directions for making breads, cakes, rolls, waffles, fritters, salads, puddings, muffins, ice cream, ices, jellies, catsups, sauces, pickles, wines, etc 104

Recipes, pharmaceutical: Extract of vanilla; extract of soup herbs; antiseptic cologne; solution of citrate of magnesia 342

Recipes, useful: Skeletonizing leaves, preserving autumn leaves, fumigating paper, soluble blue, paste, Babbitt metal, phosphorescent paint, stains for horn, walnut stain, to render fabrics fire and water proof, moth and roach exterminator, to color butter, etc 159

Recipes, valuable and useful, 36 in number, for the confectioner, the baker, and the cook, by J. W. Parkinson 136

Recipes, valuable: Quick process for making vinegar; how to bleach gutta percha; how to etch on glass; how to prepare battery carbons; how to make fine court plaster; glaze for pottery; how to make oxygen 313

Recorder, siphon, Thomson's *255

Record tower, London *348

Recorder, speed, Theiler's *92

Recorder, sunshine, Whipple's *369

Recorders and gauges, speed *200

Rectory, design for *389

Rectory, Llandrindod, Wales *426

Rectum, bottle in the, successful removal of by Dr. L. A. Rodenstein 294

Red dye on cotton, fast, recipe 255

Red, Turkey, by C. Koechlin 390

Redwood, durability of 308

Reed-making machine, Barraclough's *3

Reeds for looms, how made *130

Reefs, coral, origin of, by A. Geikie *346

Reel for silk, new *68

Reel for yarn, Coleby's *96

Reflecting comparator, Sexton's *96

Refraction, index of, method of determin'g 86

Refrigerating apparatus, compressed air, Bell and Coleman's *215

Refrigerating apparatus of the steamships Strathleven and Dunedin *314

Refrigerating machine, air *254

Refrigerating machines, compressed air (see Air).

Refrigerating machine, dry air, Hall's *288

Refrigerating machinery, air 335

Refrigerating machines 252

Refrigerating machines, Lightfoot's *274

Refrigerating car, railway *89

Refrigeration: ice machines; refrigerating machines; ice-water refrigerators 284

Refrigeration, mechanical, by J. K. Kilbourn 279

Refrigerative cover for the sick, Dumontpallier and Galante's *234

Refuse, city, furnace for consuming *191

Refuse, city, furnaces for destroy'g, Fryer *283

Refuse, town, burning of at Leeds *362

Register, electric, and Koenig's tuning-forks, by Prof. Le R. C. Cooley *98

Regulator, automatic, for thread lustering machines *337

Regulator, solar, new *414

Regulators and pumps, Gauchot's *407

Regulators, speed, for turbines and steam motors, Bell's *396

Reichenbach's experiments and the Psychical Research Society 394

Reiss, Philipp, inventor of the telephone, by S. P. Thompson 403

Relay, Theiler's *93

Relief, exaggeration of 139

Remembering, ways of, by J. Mortimer Granville, M.D 203

Reporting machine, stenographic, Michela's. *278

Reptile bird (Archæopteryx) *241

Repulsion, static, electrical 56

Reservoir, cement, for water *388

Reservoir, water, beton, how to construct *321

Reservoirs, air, for locomotives *197

Residence, Milford Manor, Salisbury, Eng. *313

Resin, gums, and waxes, notes on 300

Resorcine, eosine, and the other derivatives of resorcine, manufacture of, by Bindschelder and Busch 152

Rest, value of in the treatment of disease, by Dr. Arthur E. T. Longhurst 184

Retort for oil gas, new, Drescher's *310

Retort for oxygen, Chadwick's *77

Retort, gas machine, new, Van Kannel and Towsley's *1

Retort mouth-piece lid, self-sealing, Grice's. *296

Retort pipes, apparatus for preventing obstructions in *425

Retorts, fire clay, how to prevent cracking 398

Retorts, gas, methods of setting *22, *43, *98

Retorts, gas, with regenerative furnaces *401

Retorts, vertical, for distilling shale and other minerals, Bennie's *57

Retouching for beginners, by H. Morgan *276

Reversed negative process, Obernetter's 135

Reversing gear, West's *136

Revolver, pocket, Turbiaux's *410

Rhea, or China grass, by J. R. Boyle 345

Rhe-electrometer, Marianini's, for the study of atmospheric electricity *399

Rhe-electrometer, Meisens' *29

Rheolyzer, Wartmann's *354

Rheometer, photo, for determining the unit of light *336

Rheometer, Zenger's *421

Rheostat, De Combette's *391

Rheostat, improved, Groves' *36

Rheostat light, Edison's *309

Rheostatic machine, Plante's *414

Rheumatism, acute, cure of by salicin and salicylic acid, by William Squire, M.D 213

Rheumatism, acute, treatment of by hot soda baths 246

Rheumatism, acute, treatment of, by Alfred Stillé, M.D. A valuable paper 299

Rheumatism, articular, acute, value of salicylic acid in the treatment of 25

Rheumatism, by M. P. Greensword, M.D. Experience of the author in the successful treatment of rheumatism in the West Indies, where the disease occurs under complicated forms. Mode of treatment, external and internal; prescriptions 291

Rheumatism, chronic, articular, and rheumatoid arthritis; a lecture by Dr. Alf. Stillé 190

Rheumatism, turpentine bath treatm't of. 84

Rhinoscope, and how used *108

Rhubarb (pie-plant), culture of 262

Rhus, beneficent and toxical effects of the various species of, by T. J. W. Burgess, M.D 273

Rhus poisoning, remedies for, by J. G. Steele. 95

Rhus poisoning, sassafras in 372

Ribbon and tape, machine for stretching *389

Rice as a brewing material 281

Rice, cultivation of in the United States 90

Rice, maize, and barley, composition of 288

Rice-paper, Chinese, how made 151

Rifle barrels, how to color brown 155

Rifle, breech-loading, Pieri *131

Rifle factory, at Enfield, England 307

Rifle, Soper's *115

Rifles, how made *24, *25

Rifles, military, most suitable calibers and ammunition for 5

Rig for small boats, Taylor's *163

Rig, for steamers, Forbes' *382, *391

Rigs, for boats, new, by R. B. Forbes *133

Rigs for small boats and yachts *131

Rigging machine, improved *330

Ring-spindles, novelties in *344

Ring-spinning implements, for *234

Ring-spinning, improvements in *213

Ring-spinning, improvem'ts, Tatham's. *220

Ring-spinning, Loeffel's improvements. *219

Rings, magic, an optical illusion *410

Rings, metal, manufacture of, by A. Taplin. *28

Rings, seamless, machine to manufacture. *371

Rings, vortex, liquid, by T. Hart *400

Rings, vortex, of liquids and gases, by A. Guebhard *301

Ringworm, treatment of with leaves of Cassia alata, by Dr. D. Foulis 65

Rio Grande, botany and geology of the country bordering in Texas and Chihuahua, by Dr. J. S. Newberry 411

Rivet-heating furnaces, Bonchacourt and Delille's *66

Riveting in boiler construction, report of committee on to Master Mechanics' Assoc *296

Riveting machine, hydraulic *266

Riveting machines, hydraulic, Tweddell's. *140

Riveting machine, improved, Muir and Co.'s. *128

River beds, deepening of, by G. H. Henshaw. 16

River channels, ancient, in California 75

River Clyde, engineering operations along. 57

River system of America 256

Rivers, the gauging of, by D. F. Henry, C.E. 31

Rivers with high banks on one side and low banks on the other, what is the cause? By John Hepburn 301

Riveting, equations of strength, etc., by J. B. Holbrook 424

Road washings as a fertilizer 290

Roads and streets, prairie, improvement of, by T. J. Nicholl, C.E *151

Roads, country, how to make *335

Roads, macadamized, harrow for breaking up surface of *381

Roads, tunnels, bridges, and canals, by John Fowler 353

Roads, wagon, iron tramways for 122

Robert College, Constantinople, by Rev. G. Washburn 122

Rockets, sky, composition for 317

Rockets, war, explosion of, Woolwich Arsenal. *410

Rocky Mountains, botany of, by Dr. J. D. Hooker 105

Rock-boring machinery *94

Rock-boring machinery, Dubois and Francois', at the St. Gothard Tunnel *12

Rock-boring machinery, pneumatic *92

Rock-boring machinery, sketch of the history and characteristics of 140

Rock-boring machinery and tunnels *109

Rock-breaker, cheap, how to construct *38

Rock-breaker, Loizeau's *398

Rock-cleaving without powder 62

Rock-drill and air-compressor, Ferroux's, by H. W. Pendred, C.E 20

Rock-drill, atmospheric, Chenot's *353

Rock-drill, Burleigh *48

Rock-drill, hand-power, Jordan's. *111, *117

Rock-drill, Kainotoman *23

Rock-drill, percussion, Welker's *369

Rock-drill, Sachs' *263

Rock-drilling machine, Barlow and Co.'s. *49

Rock-drilling machinery, by John Darlington. *103

Rock-drills, submarine, by E. Moore *56

Rocks, igneous, by H. C. Sorby 255

Rocks, primary, origin of, by H. Hicks 12

Roebling, John A., the eminent engineer, biographical sketch, with portrait *393

Roller-bearings, anti-friction, Higley's *89

Roller laps in spinning, prevention of *207

Roller mill, St. Paul *347

Roller milling at Budapesth *341

Roller milling, theory of *200

Roller mills, Ganz's Mechvart's patent *166

Rollers, calender, how ground *174

Rollers for grinding cards, Edwards' *137

Rollers, porcelain, for milling *162

Rolling-mill engine, vertical *232

Rolling-mill for dressing and rounding bar iron, Chuwab's *362

Rolling-mill for iron plates *221

Rolling-mill for making corrugated iron. *286

Rolling-mills, improved, Jepson's *6

Rolls, bending, boiler plate, English *302

Rolls, calendering, Voith's *210

Rolls, chilled iron, manufacture of 34

Rolls, steel, manufacture of, J. Morton Poole and Co.'s process *36

Roll-welding in the manufacture of steel-edged iron cutters *9

Roman candles, how to make *209

Rome, ancient, tradesmen of 253

Rome, excavations in at the southeast end of the Forum *241

Rome, remarkable discoveries in the Palatine Hill 157

Roof, church, of iron, novel 3

Roof, iron, 42-foot span *237

Roofing paint, recipe for 113

Roofs, curvilinear. An important and valuable paper, illustrated by fifty figures, exhibiting the forms of all the principal styles of curvilinear roofs now in use, embracing the drawings of the roof of the great railway depot of the Northern R.R. of France, Paris *40, *42

Roofs, great span *253

Roofs, iron, large, English 307

Roofs, loads on, table for calculating 255

Roofs, railway station *58

Roofs, straw, how to make *354

Roofs, zinc, durable coating for 206

Root-cutter, centrifugal, Barbet's *431

Roots, convenient way to store 271

Roots, value of for milch cows 262

Rope-driving gear in cotton mills, Goodfellow's *80

Rope, straw, machine for making *341

Rope, wire, connections for mining cages, Baumann's *247

Rope, wire, transport, three systems of *328

Rope, wire, wear of 6

Ropes, hoisting, loads and strains on, by W. S. Hall 396

Ropes, wire, by A. Garcenot 348

Ropeway, wire, the Monte Penna *278

Rosa gallica in pharmacy 330

Rosaniline hydrochlorate or magenta, how made *341

Rosaniline, question of, present status 320

Rose farming, hints on 212

Rose, Gloire de Dijon, as a winter bloomer 371

Rose oil, or otto of roses, by C. G. W. Lock 275

Rose, tea, cut, trade in 253

Roses, a life-time with, by Rev. S. R. Hole 302

Roses for garden culture, best 263

Roses, garden culture of 353

Round shoulders, or antero-posterior curvature of the spine, treatment of, by C. F. Stillman, M.D. A valuable paper *403

Royal Courts of Justice, London *368

Rubber fabrics, improvement in the manufacture of *390

Rubber, India, artificial 39

Rubber tires for vehicles *410

Ruby, artificial production of 111

Rudder, telescopic, Stewart's *222

Rudders and stern frames of crucible cast steel for the steamer La Plata *375

Ruins at Palenque, exploration of *205

Ruins, Aztec, in Southwestern Colorado *92

Ruins, Aztec, Mexico *226

Rule, slide, spiral, Fuller's *181

Ruler for drawing converging straight lines, Sinigaglia's *363

Ruling machines, paper, Hickok's *396

Rust, a practical protection against 393

Rust in metals, compound to prevent 235

Rye plant, value of 354

Rye, plowing in 32

Rytiodus, or fossil sea cow, skeleton of, discovery *262

S

Saccharifier, high pressure, Henze-Ellenberger. *168

Saccharimeter and compensator, improved. *374

Saddle leather, machine for stuffing *368

Sadiron, mechanical *192

Safes, express and bullion, by M. A. Dalton 300

Safety device for cars, Root's *9

Safety disk for boilers, Rowan's *93

Safety hooks, Booth and Sugden's *252

Safety lamp, Olding's *149

Safety plates for steam boilers, Rowan's *96

Safety plug fusible for boilers, Adams' *335

Safety valve, Adams' *51

Safety valve, Blake's *51

Safety valve, Eaves' new *141

Safety valve, Fletcher's *44

Safety valve, Klotz's *95

Safety valve, lock-up, Robey's *129

Safety valve, Schmid's *44

Safety valve, spring, Atock's *54

Safety valve, test, Wright's *44

Safety valves, equilibrium, Turnbull's *325

Safety valves, lock-up, Wilson's *235

Safety valves, when they are not safe 217

Sail boat building, the question of keel in 44

Sail boats, rigs for *131

Sail boats, rules for the management of, applicable to cat-rigged boats, single-sail rowboats and other small pleasure boats 37

Salicylic acid. A very comprehensive article, describing the properties and enumerating the applications of this antiseptic agent 226

Salicylic acid for the cure and prevention of diseases in cattle and live stock 244

Salicylic acid, how made 229

Salicylic acid, how to test for purity 65

Salicylic acid in acute rheumatism 213

Salicylic acid in the treatment of yellow fever, cholera, etc., by Dr. T. B. Henderson 338

Salicylic acid, latest results obtained with in brewing 332

Salicylic acid, solvent for 207

Salicylic acid, use of in the household, by Dr. Von Heyden; directions for using as a food preserver 66

Saliva and snake poison 307

Salmon, canned, Columbia River trade in 122

Salmon disease, by Prof. T. H. Huxley 329

Salmon of the Pacific, observations on, by D. S. Jordan and C. H. Gilbert 275

Saloon, great, design for *259

Salt manufacture, California 144

Salt manufacture, description of processes employed in Michigan, by S. S. Garrigues *102

Salt marshes, method of reclaiming, by W. Clift. 91

Salt mountain in St. Domingo 180

Salt mines, Wieliczka *172

Salt mines, wonderful, of Virgin River, Nev. 25

Salt in the animal economy 97

Salt, its history and influences 406

Salt, sea, its chemical composition, properties, and uses, by W. Jago, F.C.S 396

Salt, sea-water, process of manufacture at Aveiro, Portugal 52

Salt, Sir Titus, biographical sketch, with portrait. *68

Salt water, apparatus for distilling, Normandy's. *399

Salt water, solar distillation of, apparatus for. Abstract of a paper by J. Harding 405

Saltpeter caves, in Virginia, by Dr. H. Haupt, Jr., Ph.D 184

Sanatorium, Holloway, the *424

Sandalwood, derivation and uses 112

Sand and gravel driers, new, Daish's *7

Sand bars, new system of removing, experiments on at Boulogne-sur-Mer, by Ch. Bergeron *98

Sand blast file-sharpener, Tilghman's *416

Sand, movement of, study of, by Ph. Forchheimer *379

Sand, musical of, Island of Hawaii 124

Sandstone, artificial, and tripolith 339

Sandstone, artificial, how to make 183

Sandstone reefs, Brazilian 180

Sanitary appliances at the Paris Exhibition of Applied Science 220

Sanitary appliances for dwellings; illustration of the proper arrangement of sewerage and ventilating pipes in houses *369

Sanitary arrangements of houses, common defects in and remedies for, by Dr. W. H. Corfield. *397

Sanitary Exhibition, International, London. *298

Sanitation, common-sense, by T. S. Case *293

Sanitation, home, hints on. A valuable practical paper, by H. H. Collins 320

Santa Barbara and Northern Pacific coast as a resort for invalids, by R. W. Burnet, M.D. 406

Sap of trees, rate of flow and composition of, by Prof. Attfield 385

Saponifier, Droux's, improved *161

Saponine from the bark of quillaia, by H. Collier 200

Sapphire, lazulite, and lapis-lazuli, blue color, cause of 351

Sassafras in rhus poisoning 372

Saturator, "Cascade," Mondollot's, for saturating water with carbonic acid gas *372

Saturn, by T. W. Webb 212

Saturn, observations of. Abstract of a paper by L. Trouvelot *41

Saturn, rings of *155

Saturn, the wonder of the worlds, by Camille Flammarion *192

Saw accidents, device for preventing 206

Saw, band, for iron, improved *397

Saw mill, gang, Wickes' *401

Saw mills and accessories at the Centennial 36

Saw mills, curious musical vibrations in *25

Saw, steam, for felling trees, Ransome's *78

Saws, Japanese, at the Centennial *25

Saws, machine for sharpening, Huré's *199

Saws, sharpening and setting, mach. for *331

Sawing machinery for stone *54

Scaffolding, iron, Hahn's *170

Scalds and burns, chloral hydrate in, by Dr. S. S. Riddell 60

Scale, Marquois', an improved form of *132

Scale insects, by Prof. Comstock 261

Scale, vernier, and vernier microscope, how used *72

Scales, bagging, for grain, Paupier's *367

Scales, specific gravity, Parish's *14

Scales without weights, Coulon's *276

Scalp disease, oleate of mercury in 285

Scarlet fever. A clinical lecture by Alonzo Clark, M.D 239

Scarlet fever, fresh air for 314

Scarlet fever, successful method of treating, by Dr. Pigeon 58

Scarlet fever, suggestions for preventing the spread of. A valuable paper 172

Scavenging, city, at Boston, by E. C. Clarke. 227

Scheele, Carl Wilhelm, the chemist, biographical sketch of 340

School, City of London *423

School, classical, American, at Athens 416

School house, design for *98

School houses, warming and ventilation of, by Dr. F. Winsor 98

School, grammar, Queen Elizabeth, Heath. *380

School hygiene, by Dr. D. F. Lincoln 10

School life and its influence on sight, by G. Reuling, M.D 67

School, model, N. Adelaide *108

School, new, City of London *369

School of Fine Arts, Marseilles, France *97

School, preparatory, for boys, design for *364

Schools, technical, handiwork of shown at the Centennial *46

Schooner, mackerel, Spencer F. Baird *412

Schwendler, Carl Louis, the electrician. Biographical sketch 320

Sciatica, flowers of sulphur in 139

Science and engineering, by W. R. Browne 417

Science, and the improvements that it can effect in our trades and in the conditions of our workmen, by Prof. W. E. Ayrton 211

Science and war, by H. Baden Pritchard 84

Science College, Sir Josiah Mason's *255

Science, definite conclusions of: Our earth motionless. A popular lecture by Dr. Schoepper, endeavoring to prove that our globe neither rotates upon its axis nor around the sun *121

Science, industrial, recent progress of, by E. A. Cowper 299

Science, mechanical. Address by Sir W. Armstrong, F.R.S., before the British Assoc 307

Science, modern, minute measurements of, by Prof. A. M. Myer (see Measurements, minute).

Science of antiquity: decapitated horse *374

Science, physical, in our common schools. A strong argument in favor of teaching physical science in elementary schools by the experimental method, with an outline of the system, by Prof. C. M. Boutelle 286

Science, progress of during the last half century. Address by Sir John Lubbock before the British Association 301

Science, relations of to speculation, by Dr. J. W. Dawson 293

Science, side-show: 3-headed woman *372

Science, heoretical and applied, advancement in, by Dr C. W. Siemens....351, 352
Scientific phenomena and their relations. Abstract of an address by Prof. Newcomb....141
Scientific service of the U. S. Government, compensation of, by F. D. Y. Carpenter....376
Scintillometer, Montigny's....*199
Scoop, steam, improved....*189
Scraping machine for water-mains....*238
Screw coupling, differential, for pipes, Bourry's....*80
Screw cutting machine, Parker's....*397
Screw cutting mechanism, improved, Baville and Greenwood's....*155
Screw, pitch of, how determined....*92
Screw propeller assistant, McKenzie's....*200
Screw propeller, by Adolph Buonaccorsi Pistoja. An historical review of early and recent forms of the helix as applied to navigation....*370
Screw propeller, Collis Browne's....*27
Screw propeller, Crooke and Mylchreest's..*278
Screw propeller, De Bay's....*170
Screw propeller, Eyre's....*74
Screw propeller, improved, by J. E. Wilson..*1
Screw propeller, Mallory's....*145
Screw propeller, Rankin's....*29
Screw propeller, Spartall's....*16
Screw propeller, Thornycroft's....*77
Screw propellers, action of, by J. Howden.*101
Screw propellers, experim'ts on position...*272
Screw propellers, relations between power and velocity in, by John Lowe, U. S. N....15
Screw propellers, the efficiency of....*208
Screw propellers, their shafts and fittings, by H. W. Pendred....*4
Screw propulsion, by R. Griffiths....349
Screw shafts, flexible couplings for....*245
Screw steamers, useful notes for masters and officers of....181
Screw ventilator, Pelzer's....*247
Screws, propeller, mechanism for changing the position of, Brooks'....*20
Screws versus paddles....198
Screws with angular threads, pitches for....127
Screwing and tapping machine, Bowker's..*11
Scroll makers, tools for....*257
Scrubber and washer, Anderson's....*192
Scrubbers and washers, gas, new mode of working, by R. H. Patterson....74
Sea sickness, cure for....67
Sea sickness: Theory of the mode in which the affection is produced, and hints on its treatment, by Dr. J. R. Stocker....322
Sea sickness, treatment of by the trance state, by Prof. E. P. Thwing....402
Sea water, apparatus for the conveyance of, Hayes'....*268
Sea weed, its composition and various uses.198
Seals, fur, their habits and mode of capture..398
Sealskins, how dressed....345
Seeds, how to select, prepare, and preserve..300
Seeds, how to sow....165
Seeds, jumping, curious....*55
Seismograph, or instrument for recording shocks and railway oscillations, Carlile's....*41
Selenium, action of light on, by Dr. Charles William Siemens....14, 24
Selenium, influence of light and heat on. Abstract of a paper by Prof. W. G. Adams....23
Selvage, strong, apparatus for making....*331
Semolina, apparatus for manufacturing..*21
Separating machine, magnetic, for ores.*306
Separator, ore, magnetic, Buchanan's....*425
Serpents, Pharaoh's, how made....*259
Serpents, poisonous, and their venom, by Dr. G. A. Stockwell....421
Sewage, A B C process for treating, by C. Rawson....37
Sewage and health of towns; a practical experience with the dry system, by Dr. Alfred Carpenter....80
Sewage and sewerage, Gardiner's report on..389
Sewage, apparatus for clearing....*243
Sewage disposal, by James Craggs....257
Sewage disposal for isolated houses, by George E. Waring, Jr....387
Sewage, household, utilization of, by Prof. J. Thausing....153
Sewage, notes on the treatment of at Manchester, Salford, and Birmingham, by P. Le Neve Foster....79
Sewage, pneumatic, Berlier system.*348, *352
Sewage, purification of, by H. Robinson. The practical and economic results reached in perfecting the purification of sewage by chemical treatment....154
Sewage question. Abstract of a paper by C. N. Bazalgette....64
Sewage system of Paris....141
Sewage, what shall be done with it? By A. N. Bell....425
Sewage works for small towns; designs made by Latham, for the town of Skipton, Eng.*75
Sewer gas and its dangers, by Dr. G. W. McCaskey....418
Sewer gases, and the transport of solid and liquid particles therein, by E. Frankland....67
Sewer grades, relation of to zymotic diseases, by Geo. W. Rafter, C.E....13
Sewer trap, Durat's....*145
Sewerage and drainage of cities, by Geo. E. Waring, C.E....226
Sewerage, drainage, and ventilation of houses, by R. Middleton....272
Sewerage, Pullman, showing how the sewage of a large town is profitably taken to a great farm, by Benezette Williams....*351
Sewerage system of Memphis....*284, 426
Sewerage works, Croydon....213
Sewers, intercepting and outfall, of Brighton, Eng., by J. G. Gamble....3
Sewers, pipe, manholes for, suggestions on constructing....*419
Sewing machine, carpet, Hesse's....*239
Sewing machine needles, machine for the manufacture of....*35
Sewing machinery, spring motor for....*142
Sex, determination of, and the mental and physical inheritance of children, by J. M. Granville, M.D....264
Sex, determination of in generation, by Dr. T. M. Harris....338
Sex in animals, how to control....211
Sex of children, what determines it? An interesting presentation of the most recent views of medical men upon the subject....265
Sexes, laws governing the production of in animals, Prof. Thury's views on....90
Sexes, materialistic origin of, a paper by Andrew Dewar, seeking to show that sex in either animal or vegetable life is derived from and had its origin in the duality of matter....271
Shaft, flexible, Stow's, for transmitting power in all directions....*52
Shaft, the combination, one of the great mining projects of the day....94
Shafting, couplings, and hangers....*205
Shafting, hanging and care of, by J. Lord....66
Shafting, line, how to adjust, by J. Rose..*190
Shafting, straightening and rounding machine for....*205
Shafts, method of sinking through quicksands by freezing....*420
Shaping machine, Collier and Co.'s....*75
Shaping machine, rotary, Kreutzberger's..*405
Shaping machine, Sharp's....*185
Shaping machines, application of elliptical wheels to for obtaining the slow advance and quick return motion, by C. W. MacCord....*16
Sheaf-binder a new....*284
Shearing and punching machine, Berry and Son's....*59
Shearing and punching machine, hydraulic, Chapman's....*75
Shearing machine, Collier's....*30
Shearing machine, large, for iron plate, De Berque's....*406
Shearing machine, 11-foot, Buckton....*352
Shears, circular, for cutting paper....*425
Shears, hydraulic, Tweddell's....*22
Shears, large, for cutting plate iron....*333
Shears, floating, 20-ton....*206
Shellac, process of bleaching, by J. M. Eder.126
Shellac, sources and preparation of....228
Shells, apparatus for casting, Woolwich..*309
Sheep grub, how to destroy....399
Sheep shelter, movable....*121
Sheep skins, velvet, machine for making.*266
Sheep, the best kinds of for farmers....161
Shingles, how manufactured....205
Shipbuilding at the yards of John Roach..340
Shipbuilding, hydraulic mach. tools for..*266
Shipbuilding, prog. of, by John F. Miller.209
Shipbuilders, short lessons to....*272
Ship, English, Imperieuse, and some of the newest types of the British navy....*422
Ship Inflexible, large guns of, trial tests; steel versus wrought iron; tests of armor plate..270
Ship, ironclad, Grosser Kurfurst....*134
Ship, ironclad, Nelson, British....51
Ship, iron-clad, Northampton....*158
Ship, light, Seven Stones....*262
Ship lines, Jackson's....*78, *96, *102
Ship of war, British, Dreadnought....61, *127
Ship of war Leander, British....*423
Ship, Peruvian, Huascar, capture of....*212
Ship Prince Adalbert....*418
Ship railroad, isthmus, proposed....*196
Ship railway, Capt. Eads', terms of the Mexican concession....270
Ship railway for the American isthmus, Eads'; full description of the project, with perspective views and figures, showing details....*405
Ship railway, Tehuantepec, proposed, by Chas. W. Zaremba....273
Ship railway, Tehuantepec, and the improvement of Mississippi River, by Capt. Eads....305
Ship, steel, Comus, British....*179
Ship, torpedo, Ajax, British....*351
Ship, war, Chilian, New Esmeralda....*376
Ships, air, by R. Grimshaw, C.E....137
Ship's berth, swinging, Andrews'....*8
Ships built in the United States, U. S. ocean commerce in, by W. H. Webb....272
Ships, cylindroid distribu. of buoyancy in.*218
Ship's davits, American Steamship Co.'s..*46
Ships, floats for docking....*130
Ships, iron, compass correction in, by Sir William Thomson....48
Ship's log, electric....*326
Ship's log, Kelway's....*366
Ship's log, De Normanville's....*96
Ships' models, speed experiments with....432
Ships of the Cunard fleet....3
Ships of war, by N. Barnaby....28
Ships of war, cellular syst. by H. J. Boolds...*23
Ships of war, new combination of propellers for, by G. Quick, R.N....12
Ships, protection of from loss by fire and from loss by sinking, by Donald Currie....235
Ships, resistance of, theory of stream lines in relation to, by W. Froude...*3, *4, *5, *6, *8
Ships, rolling, cause of, and description of an apparatus to prevent, by W. McNaught....*62
Ships, screw, form of stern in, and arrangement of propellers to obtain the best effects of propulsion, by Robt. E. Griffiths, C.E....181
Ships, screw, steering of....15
Ships, ventilation for, Boyle's system of...*351
Ships Ville d'Oran and Ville de Bone....*247
Ships, war and merchant, new designs for, Thompson's....*126
Ships, war, future, effect of steel hulls and steel-faced armor on, by J. D'A. Samuda....280
Ships, water ballast for, by B. Martel....*97
Ships, water-tight doors for....*151
Ships, wave-making resistance of....*74
Shoddy, microscopic tests of....*398
Shoe-soles, how to waterproof....164
Shoe-pegs and pegging machines....*197
Shoes, oak stain for, English....167
Shoes, wooden, machinery for....*329, *247
Shores and posts used in building....*94
Shorthand, a practical system of for everyday use, by James Richardson....316
Shunts, electrical. Abstract of a paper by W. H. Preece....67
Shutter, photographic, new form of....*158
Shuttle-driver, Grossenhain....*315
Shuttles, how made....*110
Siemens, Dr. C. W. Biographical sketch, with portrait....*353
Signal, electric, for night use on railways, Coupan's....*301
Signal, fog, steam, Brown's....*49
Signal, railway, Aird's....*13
Signal, railway, Ducoussos'....*380
Signal rules, official, for vessels; lights for seagoing steamers; for towing steamers; for steamers not sea-going; for Mississippi steamers; for sailing vessels; steering rules; instructions in full for all vessels and boats, and what the law requires in their management, and their equipment of lights, signals, fog horns, etc....63
Signaling apparatus, electric flash, for lighthouses, etc., Peebles'....*81
Signal apparatus, electric, Lartigue's....*315
Signals, audible, for railways, Brown's....*41
Signals, electrical, for railways, Siemens and Halske's....*65
Signals, fog, experiments with....*12
Signals, railroad, descriptions of the principal kinds now used: Block and interlocking system; Hall's electric signal; Union electric signal; Rousseau's safety signal; and Bean's atmospheric signal....226
Silk. A brief manual of instructions for the rearing and management of silkworms; description of the best varieties; their proper food and care; the preparation of the cocoons; the mode of spinning the silk from them; the reels therefor....*174, *175
Silk culture, the future of in the United States. Report of U. S. Consul Peixotto, of Lyons...324
Silk dyes, various recipes for, by M. De Vinant....266
Silk fiber, strength of, new machine (scrigraph) for testing....322
Silk, finishing machine for, Buffaud's....*149
Silk manufacture, American: an interesting review of the present state and future outlook of the industry....242
Silk, new solvent for....68
Silk reel, improved....*346
Silks and cashmeres, how to clean and how to dye with resists....218
Silk-worm culture, by J. Griffitt....355
Silkworm culture in America, why it has always failed....242
Silo and ensilage, practical tests and results in New England....320
Silo, the first....210
Silos, and ensilage....378
Silos, how to construct....242
Silver alloys with embrittling metals, experiments on, by A. E. Outerbridge, Jr....185
Silver and gold extraction. (See Gold.)
Silver and gold waste, hints on saving....307
Silver bath, how to ascertain the strength of. 64
Silver bath, an unalterable....89
Silver bromide and chloride, different modifications of....401
Silver chloride, how to convert into the metallic state....54
Silver, how to dissolve from silvered articles.336
Silver, how to recover from waste gelatine emulsion plates or paper, by J. Pike....397
Silver mill, by M. P. Boss. A valuable practical paper, giving descriptions and details of the best machinery and methods now in practice in the U. S., for the reduction of silver ores....*155
Silver mines, remarkable, of Peru....86
Silver nitrate, pencils of, how to make....81
Silver nitrate, poisonous properties of, by Henry A. Mott, Jr., Ph.D....385
Silver ores, how to test and work....134
Silver ores, mode of leaching at Baranca....141
Silver printing, permanent....406
Silver printing, rapid....144
Silver, quantitative analysis of, new method. 19
Silver, recovery of from the hypo bath....*426
Silver residues, process for recovering....403
Silver, simple method of recovering from washed emulsion....354
Silver, sprouting of, and its causes, by T. Fluegger....124
Silver tailings, treatment of in Nevada, by T. Egleston....*263
Silverware, how to clean and polish....412
Silvering glass. (See Glass.)
Singeing machine, gas, Blanche's....*44
Singing, the tonic sol-fa method of teach'g..414
Siphon, automatic, new....*171
Siphon, hydro-electric, Maxim's....*424
Siphon recorder, Sir Wm. Thomson's....*255
Siphons for sewers....*269
Siphons, how to arrange, by C. M. Percy..*364
Siphons, self-acting and intermittent, by Rogers Field, C.E....*201
Siren, steam, Brown's....*49
Sirup, starch sugar, detection of when mixed with sugar house molasses, by P. Casamajor....315
Sirups for mineral waters and other purposes, 50 valuable recipes for....77
Sirups, fruit. A valuable paper by A. G. Vogelier, giving practical directions for making various fruit sirups, such as raspberry, strawberry, mulberry, and cherry, and showing how natural fruit sirups may be distinguished from a spurious article....293
Sirups, fruit, preparation of. A valuable collection of more than forty approved recipes...350
Sizing, warp, glazing machine for....*287
Sizing machine, Atherton's....*367
Sizing of cotton goods, by W. Thompson. A valuable technical paper....80
Sizing, short history of, by Geo. Wheweil...180
Skeletons, preparation of for museum purposes, by Prof. W. H. Flower....106
Skew bevel wheels, by Prof. C. W. MacCord. *174, *176, *178
Skid, new, for raising casks, Fesselle's....*225
Skiff, gunning, Delaware River; detailed description, with working drawings to a scale....*207
Skin diseases, the use of certain instruments in the treatment of, by G. H. Fox, M.D....353
Skin diseases, topical remedies for, by John V. Shoemaker, M.D....210
Skin grafting, by Dr. R. J. Levis....215
Slag, blast furnace, improved treatment of..295
Slag blocks, for paving, machinery for....*86
Sleep, disorders of, mental, physical, hygienic, their causes and effects, by Dr. H. Povall...321
Sleeplessness, its causes and treatment, by James Sawyer, M.D. A valuable paper....134
Sleigh, design for....*410
Sleighs, novel, patterns for....*102
Slide-rest, how to make....*317
Slide-valve, how to set, by Joshua Rose. An excellent practical treatise, giving in condensed form simple and plain directions, which will enable any person to set slide valves quickly and correctly....*13
Slope stakes, new method of setting, by Paul McCombs, C.E....*369
Slotting and drilling machines, Lowery....*16
Slotting machine, vertical, improved....*310
Smallpox. A paper by Dr. Oscar C. De Wolf, giving the methods employed very successfully during the last four years to prevent the spread of smallpox in the city of Chicago....287
Smallpox, how to prevent spread of....316
Smith, B. Leigh. Brief biographical sketch, with portrait....*356
Smoke, apparatus for washing....*223
Smoke burning furnaces; description and particulars of the trials and performances of the Walker, Fisher, Eureka, Price, and Murphy furnaces, with much valuable information, by John W. Hill, C.E....213
Smoke consumer, Peyton's....*217
Smoke, economical washing of....315
Smoke from steam boilers, prevention of....*33
Smoke preventer, locomotive, Reimberr's.*61
Snake bite, ammonia in, by Dr. T. A. Elder. 92
Snake bite, rapid cure of by phenic acid....357
Snake, lignified, from Brazil....*345, 372
Snake poison, nature and action of....119
Snelus, George James, the metallurgist, biographical sketch and portrait of....*262
Snow crystals, method of reproducing the forms of artificially, by J. Dogiel....*33
Snow plows and novel devices for removing snow from railroad tracks....*46
Soap and its manufacture from a consumer's point of view....308, 325, 330, 360
Soap making machinery, Beyer Frères...*258
Soap, manufacture of in small quantities without boiling, by W. J. Menzies....258
Soaps, fulling, potash, by W. J. Menzies....259
Soaps, how to analyze....245, 287
Soaps, manufacturers', and their production, by W. J. Menzies....288
Soda acetate, manufacture of....234
Soda, artificial production of, by M. Frémy..146
Soda industry; improvements that have been introduced into the Leblanc process....*214
Soda, manufact. of by ammonia process....*265
Soda salts, manufacture of....264
Soda sulphate; full description of the Hargreaves and Robinson direct process, by Jno. Hargreaves....270
Soda sulphate; a new mechanical furnace and a continuous system of manufacturing, by James Mactear....277
Sodium and other alkaline metals, manufacture of by electrolysis....*403
Sodium, carbonate, manufacture of by the direct treatment of the chloride with trimethylamine....326
Sodium, manufacture of, new process, Thompson's....245
Sodium, tartrate, effervescing, preparation of, by Henry T. Hayhurst....26
Sodium sulphate, production of....254
Solar energy, conservation of, by Dr. C. W. Siemens....*329
Solar generator, an application of....*357
Solar heat, dynamic measurement and utilization of....*70
Solar regulator, Corneloup's....*414
Solder for silver, recipe for....82
Soldering apparatus; descriptions and illustrations of the most approved kinds....*187
Soldering iron, gas-heated....*258
Soldering iron, gas, Vangel's....*236
Soldering, method of, without the use of an iron....363
Soldering, practical directions for, with descriptions and figures of the tools necessary, and recipes for the appropriate solders and fluxes, by G. M. Hopkins....*20
Solenoid to demonstrate the constitution of magnets, Von Beetz's....*421
Solids, solubility of in gases, by J. B. Hannay and James Hogarth....225
Somnambulism and catalepsy, hysterical, induced, by Prof. Charcot....256
Sonometer and induction balance, by Geo. M. Hopkins....*196
Sonometry by electrical induction....*184
Solids, flow of, by L. S. Ware; description of some of the experiments performed by M. Tresca to demonstrate the little known fact that solids are possessed of fluidity under certain circumstances; with hypotheses to account for the phenomena observed....*82
Sound, production of by radiant energy. An interesting paper by Alexander Graham Bell, describing the researches of himself and Mr. Tainter on the action of radiant energy upon various solids, liquids, and gases; and their experiments upon substitutes for selenium in electrical receivers, upon the measurement of the sonorous effects produced by different substances, and upon the nature of the rays that produce such effects....*281
Sound, recent wonders of. A lecture by W. H. Preece....217
Sound-transmitter, Dvorack's....*424
Soundings-apparatus, deep sea....*398
Sounding-apparatus, Thibaudier....*433
Sounding-instruments, self-indicat'g, Thomson's....*103
Sounding-lead, Lecocentre's....*239
Sound waves, lantern for exhibiting....*254
Soup for infants, Liebig's, recipe for....422
Space, temperature of, and its bearings on terrestrial physics, by James Croll....230
Speech in animals; curious facts regarding the attempts of certain of the lower animals to acquire human speech....372
Speech-recorder, electrical, Gentilli's....293
Specific gravity scales, Parish's....*14
Specific gravity of liquids, how to find....*216
Specimen cup, deep-sea....*398
Spectacle lenses and their mountings and graduation....*144
Spectacles, colored, and their uses....*142
Spectacles, how made....*139
Spectrometer, Rutherford's....*177
Spectroscope and blowpipe for mineralogists, Hall's....*44
Spectroscope, measuring apparatus for...*122
Spectroscopy, by Dr. L. Ciamician....302
Spectroscopes, how used in solar work...*217
Spectrum analysis, a new method of, by William Crookes....394
Spectrum sensitiveness of printing processes, and on a new form of silver printing process, by Capt. W. De W Abney, R.E., F.R.S....*341
Specula, glass, new method of grinding by Prof. E. Thomson....*141
Speculum for a thirty-seven-inch reflector, how made, by G. Calver....214
Speed indicator for ships, De Normanville.*96
Speed indicator for trains, Westinghouse's..*64
Speed indicator, Harding and Willis'....*107
Speed indicator, magnetic, Deprez's....*356
Speed indicator, Napier's....*215
Speed indicator, new, Moss'....*6
Speed indicator, Hearson's....*204
Speed indicators, improved, Weir's....*6
Speed indicator. (See also Velocimeter).
Speed recorder and indicator, Theiler's....*92
Speed recorder, Wythe's and Richardson's.*200
Speed regulator for steam and hydraulic motors, Bell's and Prunier's....*396
Spence metal, a new metallic compound, by Granville Cole, Ph.D....222
Spherometer and its applications, by A. M. Mayer....*62
Spherometer, for measuring curvatures of lenses....*200
Sphygmograph for recording variations in the pulse....*184
Sphygmograph, new, an instrument adapted as a sphygmograph, sphygometer, cardiograph, cardiometer, etc....*8
Spider, red, how to destroy....196, *388
Spiders, specimens of, how to mount....98
Spiegeleisen microscopic examination of, by A. Martens....*165, *172, *174
Spine, curvature of, treatment of, by C. F. Stillman, M.D....*403
Spine, rotary-lateral curvature of and its treatment, by Prof. Lewis A. Sayre....111
Spinal curvature; hip-joint disease; club-foot, by Dr. L. A. Sayre....122
Spinal diseases and curvature, suggestions on the treatment of, by E. H. Coover, M.D....*126
Spinning frame, improved....*214
Spinning frame, revolving ring, Harris'..*362
Spinning frames, stop-motion for, new..*207
Spinning frames, stopping mechanism for.*337
Spinning machine, continuous, By water.*33
Spinning machine for wool, Munzinger's..*336
Spinning machines, silver guide for....*170
Spinning machinery, Northrop's....*263
Spinning, prevention of double roller laps and foul piecings in....*207
Spinning, ring, implements for....*234
Spinning, ring, improvements in....*213
Spinning, ring, improvem'ts in, Tatham..*220
Spinning, ring, Loeffel's improvement in..*219
Spirit-meters, Augenstein's, Wenver's, and Tice's....*200
Spirits, distilled, apparatus for aging....*12
Spiritualism; abstract of a paper by Dr. W. Carpenter....46
Splint, cable, Dr. C. F. Stillman's, for the treatment of fractures....*100
Splint, new, for fore-arm and hand, by Dr. E. H. Coover....*68
Splints, paper, how made, by Dr. Speare.... 92
Splints, plaster of Paris for fractures, by Dr. Jno. Croft....133
Spontaneous combustion, by Charles W. Vincent. A valuable and interesting paper....81
Spontaneous generation, abstract of a paper by Prof. Tyndall....90
Spottiswoode, William. Biographical sketch with portrait....*149, *388
Spring motor. (See Motor).
Springs, spiral, how to make, by Joshua Rose, with figures of easily made tools, and full practical directions for working, including hardening and tempering....*20
Springs, underground, how to trace, by Daniel Ramee....*269
Sprinkler, automatic, Parmelee's....*363
Spur-wheels, the limiting number of teeth for; a new method of determining the least number of teeth that can be assigned to a wheel when the diameter, pitch, and arc of recess of the one that is to engage with it are given; by Prof. C. W. MacCord....*306, *370
Square, carpenter's, how to use....*88, *89
Square root, method of approximating to..423
Squeezer, Menelaus', an improvement on, by J. Head....*81
Squeezing machine for puddlers' balls....*78
Stadiometer, geographic, Bellomayce's....*38
Stage scenery, how painted and set....290
Stains and grease-spots. A valuable paper, giving directions for cleansing all kinds of fabrics from any stain whatever....158
Stairs, cast iron, design for....*60
Stairs, valuable hints on construction of....248
Staircase in Jacobean style....*53
Staircase, twin, elevator, and light-shafts..*28
Stamping mill, rotating, Fisher's....*260
Stamps, forging, Longworth's....*86
Stamps, hand, rubber, how to make....83
Stamps, ore, pneumatic, Scholls....*67
Standard time....*428
Stand-pipe at the Calumet Mine....*371
Stand-pipe for Bloomington, Ill., Waterworks, by H. M. B. Birkinbine....*11
Starch and the transformations induced by organic and other acids, by F. Salomon....412
Starch apparatus, Angele's....*415
Starch, apparatus for boiling....*290
Starch-making apparatus, an easily constructed, for farmers....*313
Starch, manufacture of at Maguex-le-Gabion, France. Full description, with figures showing arrangement of plant....*407
Stars; an interesting account of the results that have been obtained from a close study of the solar system in recent years, by Prof. Isaac Sharpless....273
Stars, proper motions of, by Prof. R. Grant..349
Stars, temporary and variable, origin of, by Prof. Bickerton....163
Stars, the scintillation of and meteorological phenomena....*199
Statuary, bronze, Titania....*409
Statuary in sheet metal....*407
Statuary, Postal Union, Hanover....*329
Statue, Germania, in the Niederwald....*412
Statue, La Architectura, Monteverde's....*363
Statue, new, La Tuffolina....*181
Statue of Charlemagne, by Rochet....*139
Statue of Columbus, new, Madrid....*367
Statue of Denis Papin....*254
Statue of Galvani....*224
Statue of Hermes, Praxiteles', Schafer's restoration of....*394
Statue of Joan of Arc....*256

Statue of "Liberty," Bartholdi's. An account of the progress of the work of construction..*313
Statue of Librelei, Cauer's.....*433
Statue of Luther at Eisleben, with an account of festivities on inaugurating it.....*414
Statue of Professor Faraday, in the Hall of the Royal Institution.....*69
Statue of William Harvey at Folkestone...*300
Statue, "The African," Cavon's.....*152
Steam and air, superheater for.....*258
Steam and water joints, how to make, by Joshua Rose. A valuable practical paper.....41, 43
Steamboat, Fulton's first, with plans reduced from the inventor's original drawings.....*273
Steamboat Grand Republic, new.....*121
Steamboat, iron, Pilgrim, engines of.....*349
Steamboat, lake, Swiss.....*395
Steamboat Mary Powell, detailed description of her machinery, and an account of her performance, by Chief Engineer Isherwood, United States Navy.....188
Steamboat Silva Americano.....*94
Steamboat, the first.....261
Steam boilers (see Boilers).
Steam cock, Sailler's.....*425
Steam, compensatory system of generating, Cowan's.....*42
Steam condensation, memoranda on.....127
Steam condenser, Preston's.....*41
Steam cylinder, losses in, experiments on..327
Steam distribution without eccentrics, De Lahar,e's.....*411
Steam dredger for port of Colon, new.....*431
Steam, dynamical power of.....203
Steam engine and boiler for navy cutters..*32
Steam engine and boiler, portable, Shapley..*31
Steam engine, twin-screw, Wilson's.....*68
Steam engine and boiler, vertical Shanks'...*87
Steam engine and boiler, vertical, Turner's..*64
Steam engine and clay mill Jackson's.....*70
Steam engine and fire pump combined, Shand, Mason, and Co.'s.....*408
Steam engine and vacuum pump, combined, Gleason's.....*31
Steam engine, automatic cut-off, Ide's.....*424
Steam engine, beam, 100 h. p., Windsor's..*178
Steam engine, bellows, Reilley's.....*12
Steam engine, box, improved, Outridge's..*114
Steam engine, cannon, man, and the insect considered as mechanical motors.....414
Steam engine, compound beam, Borsig's...*344
Steam engine, compound, Brotherhood's..*138
Steam engine, compound, Corliss, English...*65
Steam engine, condensing, and novel valve gear, Sulzer's.....*146
Steam engine, condensing, 100 h. p.....*131
Steam engine, comp'd, Farcot's...*366, *388
Steam engine, comp'd, plowing, Fowler's..*368
Steam engine, comp'd, for yachts, Copley..*341
Steam engine, compound, Galloway's.....*305
Steam engine, comp'd horizontal, Sulzer's.*374
Steam engine, compound, Kingdon's.....*242
Steam engine, compound, portable, Marshall, Sons, and Co.'s.....*265
Steam engine, compound, small, of the Macdonnel.....*233
Steam engine, compound, theory of.....*204
Steam engine, Corliss, 1000 h. p.....*286
Steam engine for twin-screw propellers, Whiting's.....*9
Steam engine for underground hauling, Stevens'. *149
Steam engine frame, new, Finney's.....*6
Steam engine, Hampson, Whitehill, and Co..*26
Steam engine, high speed, Ridealgh's.....*397
Steam engine, horizontal, a method of compounding.....*121
Steam engine, horizontal, Belgian.....*260
Steam engine, horizontal, improved.....*248
Steam engine, horse-power of, to estimate...253
Steam engine, horizontal, Bertram's.....*93
Steam engine, improvements made in during the last half century, by J. Bourne.....7
Steam engine, a very interesting history of the rise of and its progress up to the time of James Watt, by C. M. Percy.....305
Steam engine, light, for balloons.....*286
Steam engine, marine, Vile's.....*200
Steam engine, Messenger and Co.'s.....*116
Steam engine, multi-cylinder, Billings'.....*22
Steam engine, new, Bernay's.....*177
Steam engine, non-piston age of, by Wm. Mann. Historical notes on antique and modern inventions, or suggestions of engines for raising water by steam without the use of a piston.....*115
Steam engine of the Vera Cruz.....*55
Steam engine, origin of.....*382
Steam engine, oscillating, Fournier & Co.'s.*184
Steam engine, oscillating, small, for actuating a pump, Lemonnier's.....*376
Steam engine, Outridge.....*274
Steam engine, paddle, for light draught steamboats, Wilson and Co.'s.....*77
Steam engine, Pittler and Elze's.....*320
Steam engine, portable, and novel valve gear, Armitage and Ruston's.....*49
Steam engine, propeller. novel, by Prof. C. W. MacCord.....*415
Steam engine, reversing gear for, West's..*136
Steam engine, Robertson's.....*78
Steam engine, rolling mill, Corliss.....*232
Steam engine, rotary, Comber's.....*11
Steam engine, rotary, Hodson's.....*267
Steam engine, rotary, Pinchbeck's.....*397
Steam engine, rotary, Titus'.....*19
Steam engine, semi-portable, Fowler's.....*131
Steam engine, single-acting, how to make a simple form of costing five dollars.....*279
Steam engine, spherical, Heenan and Co.'s.*403
Steam engine, straw and coal burning, Garrett's. *87
Steam engine, 8 h.p., portable, Wallis and Stevens'.....*60
Steam engine, three-cylinder, Willan's.....*5
Steam engine, 3-cylinder, Brotherwood's....*25
Steam engine, traction, 8 h. p., improved..*161
Steam engine, traction, McLaren's.....*394
Steam engine, traction, Fowler's.....*180
Steam engine, traction, Marshall's....*56, *71
Steam engine, traction, Robey's.....*6
Steam engine, traction, 8 h. p., for common roads.....*85
Steam engine, twin, for wire rope feed works, Allis'.....*403
Steam engine, vertical, and expansion gear, Weatherhogg's.....*61
Steam engine, vertical, with reversing gear, Turner's.....*116
Steam engine, Wigzell and Halsey's.....*75
Steam engine, 4-cylinder, Abraham's.....*422
Steam engine, 6 h. p., Farcot's.....*421
Steam engine, 40 h.p., Ruston, Proctor, and Co.'s.....*130
Steam engine, 10 h. p., Watte's.....*43
Steam engine, 500 h. p., compound, Sellers'.*128
Steam engines and boilers for high pressures, Perkins'.....*81
Steam engines and boilers of the steamer Lord of the Isles.....*92
Steam engines as compared with gas.....308
Steam engines, coal consumed by per horse-power per hour.....284
Steam engines, compound, disconnecting, for a tug.....*239
Steam engines, compound, disconnecting, for driving twin screws.....*85
Steam engines, compound, economy of, by W. Parker.....*341
Steam engines, compound three-cylinder, of ship Orient.....*204
Steam engines, compound, with Ashworth's variable expansion gear.....*28
Steam engines, Corliss, at the Centennial....*26
Steam engines, early, at the Loan Exhib...*45
Steam engines, economy of fuel in, results of experiments on in England.....39
Steam engines for small boats.....*158
Steam engines, torpedo boat, Normand's..*261
Steam engines, horizontal, non-condensing, proportions of, by M. W. Wheeler.....34
Steam engines, liquid fuel for, experiments..238
Steam engines in the United States about the year 1801, notes on, by F. Graff.....*45
Steam engines, marine, Young's.....*64
Steam engines of H.M.S. Nelson.....*237
Steam engines of ship City of Rome.....*248
Steam engines of ship Hudson.....*61
Steam engines, revolving cylinder, various systems of.....*211
Steam engines, single acting, simple and compound, Watts'.....*179
Steam engines of ship La France...*325, *327
Steam engines of steamer Loudoun Castle...*79
Steam engines of the steamships Limerick, Milford, and Waterford.....*88
Steam engines, traction.....*229
Steam engines, vertical, Bietrix's.....*404
Steam engines, vertical, Turner's.....*111
Steam ejector, Nagel and Kaemp's.....*19
Steam, escaping, temperature of.....*199
Steam fire engine, English.....*371
Steam fire engine, French.....*364
Steam fire engine, Gould's.....*27
Steam, gas, and air engine, Simon's.....*168
Steam, generation of, and the thermodynamic problems involved, by W. Anderson.....420
Steam generator, Herreshoff.....*169
Steam governor, (see Governor).
Steam hammer, (see Hammer).
Steam hammers, Thwaites'.....*396
Steam, how it increases its own heat.....83
Steam in water. A theory to account for the immense force and disastrous effects of boiler explosions.....155
Steam launch, (see Launch).
Steam launch, very fast; description of a small, high speed propeller launch designed to carry eight or ten persons; with perspective view, elevational section, and plan.....*81
Steam power, application of to road locomotion, centenary of, by M. Macfie.....424
Steam power, cost of, by C. E. Emery.....429
Steam power, economic, by W. B. Le Van...360
Steam pressure regulator, D'Arsonval's....*277
Steam quieter; apparatus to deaden the sound of escaping steam.....*196
Steam shut-off automatic, Hughes'.....*89
Steam sloops, American, machinery of....*57
Steam, superheated, economy of for saturated steam, by S. N. Carrol.....372
Steam, superheating, Carvalho's system...*112
Steam trolly, Cooke's.....*63
Steam, water in, measurem't, by P. Guzzi..*114
Steamer Albatross, U. S. Fish Commission.*408
Steamer, arctic, Eira, sinking of.....*356
Steamer, arctic, Jeannette, loss of.....*339
Steamer Austral, remarkable sinking of...*372
Steamer, catamaran, new.....*225
Steamer, hydraulic-reaction, Maginot and Pinette's.....*415
Steamer Inflexible, British, armament of...*8
Steamer, ironclad, Independencia, Brazil..*117
Steamer, ironclad, Inflexible, British.....*122
Steamer, ironclad, Italia.....*257
Steamer, ironclad, Richelieu, destruction..*270
Steamer La Normandie, engines of.....*402
Steamer, light draught, stern-wheel.....*108
Steamer Lord of the Isles.....*92, *96
Steamer Manhattan, cylindroid.....*218
Steamer Montana, stern-wheel.....172
Steamer, new, for the Mexican National Construction Company, specifications of.....282
Steamer, new, Invicta.....353
Steamer, new, propelled by water jets, Fleischer's.....*308
Steamer, portable, Le Stanley.....*425
Steamer, torpedo, Polyphemus....*291, *297
Steamer Riverdale, exploded boilers of...*407
Steamer, steel, Merton Hall.....*325
Steamer, stern-wheel, light draught, new..*398
Steamer Thetis, propeller and shaft of.....*81
Steamer Trenton, U. S., crank-shaft of.....*27
Steamer, twin-screw, shallow-draught, for the River Congo.....*394
Steamer Vera Cruz, engine of.....*55
Steamer, war, Bacchante, British.....*193
Steamer, war, Duilio, Italian, new.....*142
Steamers, ironclad, Austrian, novel features in, by E. J. Reed, C.B., M.P.....*24
Steamers, light-draught, paddle engine for, Wilson's.....*77
Steamers, mail, Irish, new.....*85
Steamers, new rig for, Forbes'....*382, *391
Steamers, ocean, criticisms on the forms of and the arrangement of state-rooms and spaces for cargo, machinery, and fuel, by R. B. Forbes. 50
Steamers, paddle, waves raised by, and their positions relative to the wheels.....*283
Steamers, stern-wheel, new.....*217
Steamers, war, Dolphin, Atlanta, and Chicago. *432
Steamship, armor-plated, Admiral Duperre, French.....*198
Steamship Britannic, compound engines...*51
Steamship City of Rome; general description, with sections showing the arrangement of her engines and boilers.....*248
Steamship City of Rome, largest mercantile ship afloat.....293, *307
Steamship, Cunard, Servia.....*284
Steamship, double rudder and movable propeller, by Captain Sadler.....121
Steamship, double-screw, Almirante Brown. *296
Steamship Dunrobin Castle.....*149
Steamship Gallia, Cunard.....*202
Steamship G. S. Blake and her apparatus..*398
Steamship, ironclad, Agamemnon, British..199
Steamship La Normandie.....*366
Steamship Orient.....*204
Steamship Violet, of the London and Northwestern Railway Co.....*386
Steamship, war, Inflexible, British.....*316
Steamships, high-speed, Lundborg's. A design for an ocean passenger steamer, which, while affording ample space for passengers and cargo, has been prepared with the primary object of attaining a speed of twenty to twenty-one knots with a small expenditure of power.....*294
Steamships of the navy, most economical speed for, by John Lowe, P. A. Engineer U. S. Navy. *198
Steamships, rudder-power, by R. Clark...*134
Steam, the specific heat of. An examination of Regnault's theory, by J. Macfarlane Gray...342
Steam, the quality of, by John W. Hill.....302
Steam trap, Peyer's.....*41
Steam tromp, Hemptinne's.....*327
Steam tug for canals, new, Byrne's.....*3
Steam, water mechanically suspended in, measurement of, by P. Guzzi, C.E....*114, *395
Steam wheel, Thomas'.....*288
Steam yacht (see Yacht).
Steaming apparatus for printed textiles..*143
Stearine, saponification, acidification, and distillation of, apparatus for.....*403
Steel and iron (see Iron and Steel).
Steel and iron wire; effect of immersion in acidulated water, by Prof. D. E. Hughes.....237
Steel and steel-like metals, neutralization of phosphorus in, by Richard Brown.....202
Steel and other ingots, apparatus for reducing, Billings'.....*25
Steel, articles of, how to harden.....206
Steel, Bessemer, a brief history of, by Mr. Bessemer.....*183
Steel, Bessemer, and steel rails, manufacture of, by C. B. Holland.....*124
Steel, Bessemer, on the use of a mechanical agitator in the manufacture of, by W. D. Allen.*316
Steel bloomery, Catalan, by Prof. W. M. Williams.....*40
Steel, cast, manufacture and uses of, by Henry Seebohm.....282
Steel casting, apparatus for, Scott's.....*126
Steel, casting, use of alloys of silicon and manganese to prevent blow-holes in, by S. Kern.....81
Steel castings, solid. Abstract of a paper by F. Gautier, with remarks thereon by Mr. Bessemer and others.....70
Steel compressing. A paper by Alfred Davis on the steel compressing arrangements at the Barrow works.....247
Steel, cracks in, and annealing of.....*335
Steel, deposition of on copper, solution for. 207
Steel, ferro-manganese, manufacture of, by M. F. Gautier.....21
Steel, fluid, consolidation of, by A. Davis....202
Steel, hardening and tempering, theoretical considerations connected with, by C. Roberts...397
Steel, hardness of different kinds, simple method of comparing electro-magnetically.....3
Steel, heated, apparatus for testing.....*332
Steel, how to anneal in boiling water.....233
Steel, how to harden and temper, by Joshua Rose. A valuable paper.....95, 103, 105
Steel ingots, successful rolling of, with their own initial heat by John Gjers.....*360
Steel and iron, preservation of, Barff and Bower processes.....*287
Steel, its manufacture and working, constitution, qualities, tempering, etc., by D. Chernoff. A valuable treatise.....*36, *37
Steel, magnetization and demagnetization of, by Prof. Mayer.....*207
Steel, manufacture of, by the Bessemer and Siemens Martin processes, removal of sulphur in, by Geo. J. Snelus.....181
Steel, manufacture of by the Larkin process. 67
Steel manufacture; elimination of phosphorus in the Bessemer converter, by Sidney G. Thomas, F.C.S., and Percy C. Gilchrist, F.C.S.....184
Steel manufacture, the basic, dephosphorizing process in, by Jacob Reese.....285
Steel, nitrogen in, by A. H. Allen.....200
Steel, on the hardening, tempering, and annealing of. A valuable paper.....221, 222
Steel, recent progress in the manufacture and applications of, by Prof. A. K. Huntington.298
Steel, tempered, molecular rigidity of, as indicated by the induction balance, by Prof. D. E. Hughes, F.R.S.....375
Steel tempering furnaces, Armstrong's...*13
Steel, treatment of for the construction of ordnance and other purposes, by Sir W. G. Armstrong.....355
Steel, Sheffield, process of manufacturing, by Prof. W. M. Williams.....*40
Steel, Siemens-Martin, by Sergius Kern.....239
Steel, soft, and ingot iron.....94
Steel, solid, application of to small arms, projectiles, and ordnance by F. Gautier.....*309
Steel, some new suggestions in regard to, by W. Anderson, M.I.C.E.....231
Steel, spring and tool, hints on tempering....71
Steel, strength of, influence of surface condition on. A paper describing the results of experiments recently undertaken in England to ascertain the strength of steel under variable surface conditions.....*302
Steel, varying condition of carbon in, and its influence on Eggertz's coloration process, by J. S. Parker, F.I.C.....248
Steel, why does it harden? by William Metcalf, C.E.....223, 224
Steelyard without weights, Tengelin's.....*258
Steering apparatus, pneumatic, Baird and Lewis.....*2
Steering apparatus, Bow and McLachlan...*13
Steering apparatus, Kunstadler's.....*136
Steering apparatus, Wilson and Co.'s.....*332
Steering gear, hand and steam, Rogers'..*259
Steering gear, Heathorn's.....*208
Steering gear, hydraulic, Lafargue's.....*142
Steering gear, steam, Higginson and Co.'s, Wigzell's, and Donkin and Nichol's.....*334
Stereoscope and its uses.....*143
Stereoscopes for large pictures.....211
Stereoscopic transparency printing, Breese's method.....123
Stereotypes, how to make.....310
Stereotyping and stereotype machinery..*191
Stethoscope, flexible, Paul's.....*302
Stevenson, George. A comprehensive account of the life and labors of the father of railways, illustrated with a portrait, a view of his birthplace and of the first railway coach and locomotive, and with a cut showing the difference between the earliest and latest locomotives*290
Stiles, a cure for.....387
Still, bromine, new, Arvine's.....*60
Still, Egrot's, for continuous distillation....*252
Still for essential oils, Heywood and Co's..*292
Still-head and condenser, new, Rice's.....*95
Still, portable, Joya's.....*316
Stills, stationary and portable, Egrot's.....*353
Stitching machine for bookbinders, Neidlinger's.....*110
Stive room, new.....*330
Stoker, mechanical, Henderson's.....*77
Stoker, mechanical, McDougall's.....*250
Stoker, mechanical, Sinclair's.....*375
Stokers and smoke preventers, mechanical.. 90
Stone age, how implements were made in, by B. B. Redding.....198
Stone, artificial.....154, 355
Stone, artificial and cement-beton.....325
Stone crusher, oscillating, Motte's.....*147
Stone cutting machine, Atchison's.....*169
Stone cutting machine, McDonald's.....*396
Stone cutting, tools used in.....*113
Stone dressing mach., Brunton and Trier.*132
Stone grinding and polishing machine, Salmon and Crossland's.....*261
Stone, lithographic, whence derived.....81
Stone masonry and building stones, nomenclature of, by J. James R. Croes, William E. Merrill, and Edgar B. Van Winkle.....*113
Stone sawing machinery, by H. Conradi..*54
Stone working machines and tools.....114
Stones, what to do with on farms.....317
Stopcock, an easily constructed.....*186
Stopper, asbestos, for combustion tubes, how to make.....287
Stoppers, glass, how to remove when fixed..372
Stoppers, glass, etc., how to manipulate...*290
Storage batteries (see Batteries).
Stove, charcoal, a cheap.....*186
Stove chimney in enameled earthenware..*364
Stove, drying, for printed sheets, Renault..*304
Stove, gas, See's.....*415
Stove, gas, Schonheyder's.....*352
Stove-heated rooms, the air of. A paper by W. Matticu Williams.....323
Stove, hot-blast, Weimer's.....*45
Stove, smoke-consuming, Mousseron's.....*364
Stoves, hot-air, and hot-water chimneys...*213
Stoves, hot blast, how to compute the heating surface of.....420
Stoves, gas. A paper by Dr. James Adams.228
Stoves, gas, apparatus for regulating the temperature of.....*263
Stoves, grass burning, Mennonite.....*132
Stoves, hot blast, Cowper's. Illustrations of the general arrangements of a pair of Cowper's stoves for blowing a pair of furnaces, and a short description of the same.....*235
Stoves, regenerative. A sketch of their history and notes on their use, by J. N. Hartman.*235
Straightening machine, for rails.....*53
Straightening machine, hydraulic, for boiler making.....*300
Straight line, how to draw, by A. B. Kempe, B.A., with 33 engravings. An important essay on the several mechanisms for drawing mathematically straight lines; directions for making simple instruments for this purpose; beautiful mathematical problems; geometrical principles involved; and full description of all the most successful apparatus...*84, *85, *86, *87
Strain indicator, Stromeyer's.....*257
Strains in structures, apparatus to measure, Clevenad's.....*252
Straw lumber, how made.....354
Straw rope, machine for making.....*341
Strawberries, how to cultivate.....299
Strawberries, how to grow in pots.....91
Strawberries, how to transplant.....423
Strawberries, preparing soil for.....209
Strawberries, summer mulching of.....88
Strawberries, winter, suggestion for.....105
Strawberry beds, yearly renewal of.....197
Stream lines, theory of in relation to the resistance of ships, by W. Froude. A paper treating of the principles which govern the behavior of a fluid, with special reference to the resistance of ships.....*3, *4, *5, *6, *8
Streams, small, utilization of.....*240
Street, George Edmund, the architect. Biographical sketch and portrait.....318, *323
Stretching machine, cloth, improved...*401
Stretching machine for ribbons and tapes.*389
Stress in bowstring girders, determination of, by Lieut. G. S. Clarke.....70
Stress, transverse, in bars of wood, iron, and steel, experiments on, by Wm. A. Norton.....18
Strikes, a way of preventing, by J. Parton..196
Strychnine poisoning, treatment of with chloral hydrate, apomorphia, and electricity, by C. M. Worthington, M.D.....193
Subway and bridge, new, London.....*427
Suction and pressure appar., Muencke's...*310
Sugar and coffee, physiological action of.....322
Sugar, beet, apparatus, Daix's.....*349
Sugar beet in France and Germany, by John Sparrow.....186
Sugar beet industry, a plea for its extension in the United States, by Ernest F. Gennert....166
Sugar, beet-root, and beet roots, by E. L. Cuil. A process of sugar extraction for farmers.....83
Sugar-cane mills, improvements in.....*156
Sugar from beet-root, strontia process of extracting.....408
Sugar from corn, manufacture of, Hirsch process.....259
Sugar from maize and sorghum.....265
Sugar, grape, and glucose, process of manufacture.....96
Sugar, how made in Cuba.....270
Sugar making. An account of the experiments of Prof. Collier in manufacturing sugar from sorghum, showing the practicability of making the latter one of the best paying crops of the country.....214
Sugar, malt, preparation and use of in brewing, by W. G. Valentine.....19, 22, 25, 28
Sugar manufacture, app. for, Mackenzie..*262
Sugar, manufacture of from maize, by R. H. Harland, F.C.S.....356
Sugar mill, multiple pressure, new.....*188
Sugar production, domestic.....312
Sugar sirups, bleaching by ozone, by Dr. A. R. Leeds.....196
Sugar, starch, a new method of refining and crystallizing, by Dr. F. Soxhlet.....375
Sugar, starch, detection of in cane sugar, by P. Casamajor.....235
Sugar, unrefined, some of the microscopic contents of.....*26
Sugars of commerce, a method of practically determining the value of, by H. A. Mott, Jr....222
Sulphate of ammonia; description of the mode of manufacture and of the apparatus employed, by G. E. Stevenson.....*268
Sulphide of carbon and alcohol, solidification of.....386
Sulphur chloride, manufacture of, by J. Carter Bell.....330
Sulphur in spent oxide, apparatus for estimating, by H. Leicester Greville.....*342
Sulphur, its distribution in nature and its chemical compounds, by C. Ehrmann.....397
Sulphur, quicksilver, and borax of Califor.. 38
Sulphur, recovery of from alkali waste by Scnaffner and Helbig's process.....*345
Sulphureted hydrogen app. Kahler's...*258
Sulphureted hydrogen generator, new, by P. Casamajor.....*19
Sulphureted hydrogen, new method of preparing, by J. Fletcher, F.C.S.....203
Sulphuric acid apparatus, experimental, by Alfred Senier.....*379
Sulphuric acid, apparatus for concentrating, Faure and Kessler's.....*17
Sulphuric acid, boiler for treating organic matters with.....*432
Sulphuric acid, concentrating apparatus..*327
Sulphuric acid, tower for, Glover's.....*258
Sulphuric acid, manufacture of, Brumlen's apparatus for.....84
Sulphurous acid as a disinfectant, by T. W. Keates.....58
Sun and certain of the fixed stars, relative ages of, by Prof. Daniel Kirkwood.....81
Sun and other intense lights, photometry of..379
Sun, constitution of as revealed by photography, by Mr. Janssen.....119
Sun, cosmical bombardment of, theory of cometary impact on the solar system, the velocity of collision, and heat equivalent of velocity, by Edgar L. Larkin.....356
Sun darkenings, historical.....187
Sun dial, new, Grootten's.....*259
Sun, distance of, new method of determining, by T. S. H. Eytinge.....358
Sun, eclipse of, Dec. 31, 1880.....*289
Sun, eclipse of, Jan. 11, 1880.....221
Sun, eclipse of, May 6, 1883.....400, 401, *402
Sun, eclipse of, 1878, as seen in the United States, report on by J. Norman Lockyer and by Prof. Henry Draper and R. A. Proctor.....*144
Sun engine, Ericsson's.....*70, *218, *422
Sun, how to tell the distance of, by E. L. Larkin. 348
Sun, oxygen in, Prof. Draper's account of the discovery of.....193
Sun, in what way it gives light and heat.....266
Sun, probable origin and age of. An interesting paper, by James Croll, LL.D.....86
Sun, proper motion of in space.....388
Sun, results of recent investigations on, by Prof. C. A. Young.....214
Sun, the, by S. P. Langley. A valuable paper. *212, *214, *216, *217, *218
Sun, the distance of, recent researches on, by R. S. Ball, LL.D. An interesting paper.....411
Sun, the spots on, by Camille Flammarion.....*9
Sunlight and skylight at high altitudes, by Capt. Abney.....*363
Suns, the universe of, by R. A. Proctor....*426
Sunshine recorder, Stokes'.....*336
Sunshine recorder, Whipple's.....*369
Sunstroke, treatment of.....29
Sunken vessels, app. for lifting, Archer's..*154
Superphosphates, home-made.....85, 171
Surface-plates or planometers, and scraped surfaces, by Joshua Rose. A valuable paper, giving practical directions for the scraping of working flat surfaces, and showing how the surface-plate is to be used during the course of the operation.....*15
Surgery, antiseptic, new apparatus for, by L. F. Sass. M.D.....*73
Surgical and dental operations, the successful administration of nitrous oxide for, by Dr. E. P. Howland.....297
Surveying by compass, by Prof. Francis E. Nipher.....314
Surveys, geodetic, apparatus for.....*163
Surveying, underground, instrum't for...*271
Swamp muck, the nature of, and its value in agriculture, by Dr. James R. Nichols.....320
Sweeny, how to treat.....302
Sweeper, railroad-track. Olmstead's.....*97
Sweets, our. An interesting and comprehensive article on sweets and their adulterants; the use of glucose in candies; artificial honey and honeycomb.....314
Swimming apparatus, Boynton's.....*146
Swine, how to breed and manage, by A. W. Rollins.....387
Switch-controller, electric, Lartigue's..*315
Symblepharon, cure of, by A. W. Calhoun, M.D.....166

T

Table and chair, design for.....*213
Table, carved, design for.....*267, *284
Table from Berry Castle, near Paris.....*74

Tableaux, colored fires for, how to make and how to use.....317
Tachygraph, Meresse's, for enlarging or reducing drawings.....*332, *399
Tackle, lifting.....*319
Tacks, iron, how to tin.....7
Taking-up motion, Sagar's improved...*257
Tan-bark pressing machine.....*330
Tanner's (Dr.) forty days' fast....*242, *244
Tannic acid, apparatus for estimating, by Sir William Thomson, F.C.S.....*9
Tannic acid as a preventive of frilling and blisters.....273
Tannic acid, various methods used in its determination, values of, by N. H. Darton.331, 339
Tannin from sweet fern, a new industry....101
Tannin, proportion of in the bark of some of the trees of the United States.....376
Tanning; a paper on the first preparation of green hides and upon mineral tanning.....273
Tanning liquor for textile fabrics, recipe....39
Tanning process, improved, Heinzerling's..208
Tanning process, new, Johnston's.....*55
Tanning, science in, by H. R. Proctor.....96
Tapers, turning and fitting, by Joshua Rose. A valuable practical paper.....*18
Tapestry. painted and woven, designed for the City Hall of Lyons, by A. Dennelle.....*75
Tape-worm, remedy for, by E. Freeman..50
Tapioca, how cultivated and prepared for market.....347
Tapping and screwing machine, Bowker's..*11
Tap for effervescing liquids.....*275
Taps, frictionless, by Prof. J. E. Sweet.....*43
Taps, how constructed and how used. A valuable practical paper, by Joshua Rose.....*46
Taps, wooden, how to preserve.....400
Tar distilleries, how to extinguish fires in, by Watson Smith, F.C.S.....181
Tartaric acid, process of manufacture, by R. Worthington.....19
Tea, adulterations of, method of testing, by A. W. Blyth.....201
Tea, toxic effects of, by Dr. W. Morton.....210
Teeth, apparatus for rotating in their sockets, by J. N. Farrar, D.D.S.....*103
Teeth, cements for the; and chemical and physical effects of different fillings upon, by Charles Mayr.....291
Teeth, how to keep clean and in good condition, by C. E. Francis, D.D.S.....414
Teeth, oxychloride of zinc as a filling for, and combination and therapeutic action of some filling materials, by D. D. Smith, D.D.S.....151
Teeth, replanting, and a new method of ingrafting porcelain crowns on natural roots, by G. W. Weld, D.D.S.....199
Telectroscope; Senlecq's apparatus for transmitting to a distance, through a telegraph wire, pictures taken on the plate of a camera...*275
Telegraph, American rapid, in England..*270
Telegraph, apparatus for transmitting pictures by.....*280
Telegraph, autographic, D'Arlincourt's..*166
Telegraph cable, new kind of.....175
Telegraph cable, underground, Brooks'....198
Telegraph cables and the aurora borealis.*288
Telegraph cables, submarine, apparatus for working, Thomson's.....*13
Telegraph cables, submarine, how laid and repaired, by A. Jamieson.....*280
Telegraphy, electric, speaking, Prof. Bell's.*58
Telegraphy, electric, the first.....428
Telegraph, electric, history of, by August Guerout.....*384, *404, *405, *425, *437
Telegraph, electro-mechanical, Smith's....*5
Telegraph, electro-motor, Phelps'...*53, *56
Telegraph, facsimile, Sawyer's.....*19
Telegraph, field, without battery; the Prussian, Russian, and French systems.....*377
Telegraph, harmonic, Gray's.....*281
Telegraph, helio, Leseurre's.....*284
Telegraph, hydraulic, Montblanc's.....334
Telegraph inker, improved, Devas'.....*117
Telegraph insulators, improved.....*102
Telegraph-key, double, Byrns'.....*51
Telegraph-key, double current, new, by P. Trimmer.....*93
Telegraph key, peripheral, Cummings'....311
Telegraph, Morse, an unpublished chapter in the history of.....227
Telegraph, multiplex printing, Baudot's.*346
Telegraph, musical, La Cour's.....*10
Telegraph, optical, Mangin's.....*284
Telegraph, printing, Phelps'.....*53, *56
Telegraph, pneumatic, Guttari's.....*35
Telegraph, printing, Herring's.....*164
Telegraph, printing, Noel's.....*364
Telegraph relay, new, Vyle's.....*264
Telegraph relay, Theiler's.....*93
Telegraph repeater, improved.....*43
Telegraph signs, Morse, translation of into letters.....*426
Telegraph sounder, Belgian.....*342
Telegraph sounder, new, Theiler's.....*172
Telegraph sounders, improved, Bright's..*372
Telegraph wires, apparatus for covering, Berthouid and Borel's.....*318
Telegraph wires in cities, systems of laying wires under ground, and comparative cost..217
Telegraph, writing, Cowper's.....*213
Telegraphic codes and ciphers.....316
Telegraphing through ocean cables, mode.*10
Telegraphing without wires, experiments of Mr. Lindsay on.....354
Telegraphy and ocean cables, early days of, by Willoughby Smith.....309
Telegraphy, automatic, description of....*367
Telegraphy, early history of, as illustrated at the Paris Exhibition of Electricity.....307
Telegraphy, electro harmonic, by F. L. Pope. *131, *132
Telegraphy, new duplex system of, by S. M. Banker.....*172
Telegraphy, new system of, House's.....186
Telegraphy, optical.....*284
Telegraphy, optical, Gaumet's new apparatus for.....*308
Telegraphy, practical information on.....*67
Telegraphy, sea, Bailey's system of.....*7
Telemeter, double-reflecting, Hausch's....*35
Telemeter, electric, Siemens'.....*363
Telemeter, electrical.....*229
Telemeter, improved.....*405
Telemeter, pocket, Gaumet's.....*207
Telephone, Ader's.....*178
Telephone and battery, Harrison's.....*160
Telephone and microphone, some modifications of, by Geo. M. Hopkins.....*163
Telephone and sound vibrations, by Prof. A. E. Dolbear.....203
Telephone apparatus, action of lightning upon.....301
Telephone apparatus, simplified.....*425
Telephone, Ayres'.....*131
Telephone, Breguet's.....*126
Telephone calls, various, with working drawings and directions, how to make.....*162
Telephone, carbon, Edison's.....*127
Telephone, carbon, Edison's, Gaiffe's modification of.....*138
Telephone, D'Arsonval's.....*353
Telephone, D'Arsonval and Bert's.....*370
Telephone, Dolbear's, in England.....332
Telephone, duplex, new.....*206
Telephone exchange in London.....*413
Telephone for long distances, by W H. Preece. *367
Telephone from 1837 to 1882, by Prof. A. E. Dolbear.....*337
Telephone, Goloubitzky's.....*371
Telephone, Gower-Bell.....281
Telephone, "hammer," De Lochtlabye's..*408
Telephone, history and theory of its construction and operation, by R. M. Ferguson.....*120
Telephone, Hughes'.....*128
Telephone, improved.....*143
Telephone, improved, Husband's.....*378
Telephone, improved, Phelps'.....*156
Telephone, Kotyra's.....*371
Telephone lines, induction in, by J. W. Urquhart, C.E.....*251
Telephone, Lippens'.....*406
Telephone, micro, Dunand's.....*350
Telephone, microphone, Luedtge's.....*193
Telephone, micro, Trouve's.....*156
Telephone, new form of, by J. M. Romanis. *117
Telephone, Philipp Reis the inventor of, by S. P. Thompson, B.A.....403
Telephone, Pollard's.....*387
Telephone, Preece's improvements in; Edison's recent telephonic inventions; Lyon's new transmitting telephones; Niaudet-Breguet's watch telephone.....*163
Telephone receiver, alabaster, Gatehouse and Kemp's.....*380
Telephone receiver, new form of, Blyth's..246
Telephone receiver, Theiler's.....*362
Telephone, Reis', with his description....*389
Telephone signal, vibrating bell, Jacobi's.*345
Telephone, sound and the, by Clarence J. Blake, M.D.....148
Telephone, static, by Prof. A. E. Dolbear..405
Telephone system, Brown and Saunders'.*326
Telephone system, Dr. Herz's..*274, *312
Telephone, Testu's.....*406
Telephone, the first; description of Reis' instrument, by Silvanus P. Thompson.....*395
Telephone, the real inventor of, by M. Schuppert, M.D.....313
Telephone transmitters, Munro's.....*383
Telephone transmission by single wire and 24 Ader telephones, Moser's system.....*406
Telephone, trumpet, Herz's.....*339
Telephone, working, how to make, by Geo. M. Hopkins. A valuable practical paper, containing directions for the construction of a cheap, simple telephone; with five working drawings, and view showing line in practical operation; with full instructions how to make the magnets, size, and arrangement of wire, etc.....*142
Telephonic indicator of the torsion and revolving speed of machine axles, by C. Resio.343
Telephony, long distance, and Bennett's translators.....*373
Tele-photography, method of, and apparatus for sending pictures by telegraph.....*280
Tele-photography, by Shelford Bidwell.*290
Telescope, catadioptric, Henry's.....*184
Telescope, equatorial, simple, how to make, by E. Lasant.....*291
Telescope, equatorial, stand, simple, how to make, by T. D. Simonton.....*78
Telescope for amateurs, Newtonian, directions for making.....*179
Telescope, how to make, by G. M. Hopkins. Directions, accompanied with a complete set of working drawings to a scale, whereby any person may easily construct, at small cost, a very effective instrument.....*252
Telescope, how to try and how to use, by L. Niesten.....364
Telescope, modern, and what it has done for astronomy, by J.N. Lockyer.*107, *108, *114
Telescope, reflecting, Bessemer's.....195
Telescope reflectors, machine for polishing, Grubbe'.....*44
Telescope, small stand for, how to make..*374
Telescope, the most powerful in existence, by E. Nelson, F.R.A.S.....205
Telescopes, eye pieces for.....*399
Telescopes, eye pieces for, Nystrom's.....*7
Telescopes, improvements in, by Fritsch and Forster.....*220
Telescopes, large, relative power of.....11
Telescopes, refracting, how constructed...*1
Telescopic screen, for viewing sun spots, by B. Templar.....*141
Telethermometers, air, Rousseau's.....*307
Telpherage, or the transmission of vehicles by electricity to a distance independently of any control exercised from the vehicle, by Prof. F. Jenkin.....417, *420
Temperatures, instrument for regulating, new, Campbell's.....*2
Temperatures, low, production of.....370
Template, multiple, Burichon's.....*405
Template, draughting, improved.....236
Tennessee, archæological explorations in, by F. W. Putnam. An interesting account of the explorations of the burial mounds of a prehistoric race in Tennessee; with 55 engravings.*169, *170, *171, *172, *173
Tension, machine for testing, French.....*201
Tentering machine, clip for.....*329
Teredo and limnoria, improved method of protecting timber against the ravages of.....*113
Terra-cotta, adapted to modern church work. A paper by Edmund Sharpe, giving the results of the author's practical experience with the treatment and use of burnt fire clay, and his opinion as to its suitability for church work of the present day.....*37
Terra-cotta and fire brick, how made, by Andrew McLean Parker.....208
Terra-cotta, how to photograph on.....401
Testing and weighing machinery, Richie's..*32
Testing apparatus, cement, Fairbanks'.*424
Testing machine, Kennedy's.....*276
Testing machine, 50-ton, Williamson's.....*302
Testing machine, 200-ton, Fairbank's.....*423
Tetanus, treatment of, by Dr. Ria.....302
Textile machinery, recent improvem'ts in.*362
Textiles, bleaching by electricity.....*401
Textiles, designing for.....*170
Textiles, methods of bleaching.....147, 153
Textiles, printing, recipes for colors.....208
Theaters, electric light in.....*410
Theaters, the scenic machinery of.....268
Theodolite, mining, the first.....*46
Thermal balance, Prof. Langley's.....273
Thermal energy, difference of, transmitted to the earth from different parts of the solar surfaces, by J. Ericsson, with 6 figures.....*13
Thermo-chemical investigation, a new method of, by M. M. P. Muir.....184
Thermograph; new apparatus for making a continuous graphical record of the variations of temperature, by G. M. Eldridge.....*335
Thermograph, Montsouris.....*198
Thermo-pile, improved, by R. H. Ridout.*238
Thermo-siphon or domestic heating apparatus, Gallet's.....*297
Thermometer and hygrometer, electrical reading of at a distance, by A. W. Waters.....*431
Thermometer, air, Winstanley's.....*263
Thermometer, air, Witz's.....247
Thermometer, chrono, for testing mineral oils, Redwood's.....*12
Thermometer, deep-sea, Miller-Casella..*398
Thermometer, differential, Dufour's....*248
Thermometer, Negretti-Zambra.....*398
Thermometer, registering, Negretti's.....*8
Thermometer, registering, Richard's....*379
Thermometer scale, a very useful combination scale, full size, enabling an instantaneous comparison of numbers on the Fahrenheit, Reaumur, and Centigrade thermometers; with formulæ for converting the units of one scale into units of another.....*141
Thermometer scales, table of equivalents..347
Thermometers, by Dr. R. J. Mann. Descriptions of the various kinds in use.....59
Thermometers, Draper's dry and wet and sun, self-recording.....*209
Thermometers, how to convert the degrees of one kind into those of another.....305
Thermometers, improved, Schumacher's.*10
Thermometers, metallic, Coret's.....*208
Thermometrograph, Rysselberghe's....*421
Thermometrograph, Rysselberghe's....*148
Thermophone, by T. Wiesendanger.....*296
Thermophone, Mercadier's.....10
Thermoscope, color, new, by Filipp Hess..
Thermoscope, electric, differential, Nosworthy's.....*356
Thermostat, a simple and sensitive, by A. N. Randolph, M.D.....*420
Thrashing and finishing machine, improved, Garrett's.....*114
Thread lace, American mode of making...*34
Thresher and horse power, Hofherr's.....*49
Throat diseases, vapors for inhalation in, six formulæ for.....271
Thunderstorms, by Prof. Tait. An instructive paper upon a little understood subject.....254
Tidal and river-water indicators, new.....*3
Tidal pier, Egerton's.....*57
Tide-powers, improved by A. Mallory....*27
Tides, causes of, new theory regarding, by Prof. Elias Schneider.....*83
Tides, high, hypothetical, as agents of geological change, by Dr. J. S. Newberry.....336
Tides, influence of in lengthening the day, by Dr. Ball.....302
Timber, modern substitute for, in building..252
Timber, pine, effect of prolonged stress upon strength and elasticity of, by Prof. R. H. Thurston.....297
Timber, preservation of. A valuable paper, by W. Putnam, A.S.C.E.....236
Timber, protection of against the teredo.*113
Timber, unconsidered uses of.....137, 168
Time, a glimpse through the corridors of. An interesting paper by Prof. R. S. Ball, showing the important effect that the tides exert in modifying the rotation of the earth, and how such rotation will, at some epoch, become so slow that our months will consist of but a single day..322
Time, astronomical, instrument for marking, Horn's.....*13
Time globes, Juvet's.....*257
Time-regulator, city, Collin's.....*160
Time, standard.....*428
Time, telling the, by Prof. Waldo. An interesting account of the instruments used in observatories for determining time.....266
Time, true, how taken by regular stellar observations, by W. W. Alexander.....390
Tin can machinery, Norton's.....*398
Tin, crystallization of, experiment on.....*262
Tin crystals, method of manufacture and characteristic reactions of.....249
Tin-foil, application of to wall and woodwork decoration.....11
Tin, how melted on a playing card.....*243
Tin plate, how to crystallize.....313
Tin, removal of from tin scraps, Gutensohn's process.....114
Tin scraps, removal of tin from by electricity, by N. S. Keith.....44
Tires and axles, steel for, by Benj. Baker....332
Tires, machine for shorting and welding.*149
Titration, apparatus for, Stock's.....*169
Tobacco at the Paris Exhibition. Valuable details of tobacco culture; how to raise a good burning tobacco; how to raise mild or strong tobacco, as required; statistics of culture in various countries of the world; particulars of snuff manufactures, and the manufacture and flavoring of chewing and smoking tobacco; the most approved processes and apparatus; manufacture of cigars and cigarettes; statistics of annual consumption and production.....133, 136
Tobacco drier, Chapin's.....*8
Tobacco, estimation of nicotine in.....*174
Tobacco inebriety, by Dr. A. B. Arnold....294
Tobacco, notes on, by W. K. Glover. An interesting paper, giving in a condensed form the history and chemical composition of the plant, and the mode of manufacturing its leaves into cigars, snuff, and other commercial products.....196
Toluidines, reactions of, and method of preparation.....180
Tongue, appearance of in disease, by Dr. J. A. Henning.....193
Tongue, diseases of, by Dr. J. Hutchinson. 399
Tool-grinder, Thomson, Sterne, and Co.'s..*28
Tool-grinding machine, Mowrer's.....*10
Tool-holder, universal, New's.....*34
Tool-holders, Boville's, for lathes, planing and shaping machines, etc.....*147
Tools, Japanese, at the Centennial Exhib....*11
Tools, laboratory, apparatus for coating..*258
Tools of the pyramid builders.....*398
Tools, the proper and improper methods of manipulating.....*88
Toothache, a pleasant remedy for.....185
Tornadoes, destructive forces attending, by General W. B. Hazen.....321
Torpedo boat, Batum, Russian.....*351
Torpedo boat, Danish, new.....*424
Torpedo boat, electric, submarine, Tuck's..400
Torpedo boat engines, Normand's.....*261
Torpedo boat, first-class, Russian.....*424
Torpedo boat guns, Hotchkiss.....*428
Torpedo boat, Lightning.....*79
Torpedo boat, new, for the Argentine government.....*331
Torpedo boat, new, Russian.....*155
Torpedo boat Polyphemus, British.....*255
Torpedo boat Poti, Russian.....*415
Torpedo boat, submarine, Garrett..*218, *320
Torpedo boat, the Herreshoff.....*169
Torpedo boats, improved, Yarrow's.....*113
Torpedo boats, Russian, on the Danube.....*83
Torpedo boats, their action and effects....*385
Torpedo defense, method of.....*102
Torpedo experiments, by the English government, recent.....*142
Torpedo experiments, French.....*87
Torpedo experiments, recent, in England..*120
Torpedo-guard, improved.....*124
Torpedo ram Polyphemus.192, *291, *297
Torpedo ship Ajax, British.....*351
Torpedo, spar, improved.....*79
Torpedo steamer, lightning, British.....*74
Torpedo system McEvoy's.....*390
Torpedo vessel, Portuguese.....*246
Torpedo vessels, Thornycroft.....*79
Torpedo warfare, apparatus used in.....*355
Torpedoes, improved, Harvey's.....*113
Torpedoes, improved method of stowing and discharging from torpedo boats.....*325
Torpedoes, towing and discharging from torpedo boats.....*270
Touch, illusions of, experiment showing..*295
Tourniquet, field, a new form of, by Dr. J. M. Hunter.....*133
Touroscope, the.....*218
Tow and jute carding engine, new.....*106
Towers, construction of, by Sir Charles Anderson.....348
Toy, mechanical, the decapitated pacha....*375
Toy, scientific, Greek.....*398
Tracings, cloth, how to make.....356
Trades, unhealthy. An important series of lectures, by Dr. B. W. Richardson, pointing out the active causes that produce diseases among the working classes.....9, 10, 18, 19, 22
Train resistance. A paper pointing out the causes of the resistances that impede the movement of a railway train, and the power necessary to overcome them.....*405
Trains in motion, taking up of cars by....*256
Tramcar, compressed air, Mekarski's.....*357
Tramcar, steam, Brunner's.....*22
Tramcar system employed at Nantes.....*357
Tramway car, run by accumulators.....*408
Tramway car, steam, new.....*422
Tramway, Darjeeling.....302
Tramway engine, Beaumont's.....*248
Tramway engines, condenser for.....*426
Tramway, grooveless, Edge's system of..*220
Tramway, electric, at Paris, Siemens'.....*306
Tramway locomotives, fireless, German..*361
Tramway, wire, for coal mines.....*65
Tramways, compressed air locomotives for, Beaumont.....*317
Tramways, construction and operation of, by D. K. Clark.....134
Tramways, electric, new system of, by M. H. Smith.....*411
Tramways, Francq's fireless locomotive on. *329
Tramways, locomotive for, Brown's.....*222
Tramways, postal, electric, Siemens'.....*326
Tramways (see also Railways, street).
Transmission, electrical, role of the earth in, by Th. Du Moncel.....223
Transmitter, Blake's.....*250
Transparencies, carbon, for the lantern...383
Transparencies, direct positive.....255
Transparencies, dry plates for.....331
Transparencies, gelatine, for the lantern, how to make.....*288
Transparencies, lantern, how to color.....423
Transparencies, lantern, how to prepare..424
Transparencies, lantern slides, etc., how to mount and bind, by John Harmer.....336
Transparencies, method of producing direct in the camera; also for the reproduction of negatives (reversed or otherwise).....242
Trap, waste-water, Stiff's.....*280
Traps, siphon and S, relative values of in plumbing.....302
Trawl, how to make.....*269
Trawl, improved.....*398
Trawlers, steam, Redway's.....*396
Tree-feller, steam, Ransome's.....*78
Tree-planting as practiced in Europe.....177
Trees, a hill of, how to make.....398
Trees, artificial desiccation of by heat.....*156
Trees, cheap method of planting in waste places. *371
Trees, cleansing with soap.....186
Trees, dendrometer to measure height of..*429
Trees, directions for quickly determining the height of without apparatus.....*147
Trees, forest, of North America, a catalogue of, with special reference to the geographical distribution and economic uses of...227, 228, 229, 230, 231, 232, 233, 234, 235, 236
Trees, how to make more fruitful.....254
Trees, how to plant.....324
Trees, how to successfully transplant.....415
Trees, old and remarkable, conservation of..378
Trees, the most desirable kinds for planting in streets and public grounds.....292
Trees, timber, how to raise from seeds.....306
Trees, when to transplant.....411
Trevithick, Richard. Biographical sketch. 371, 380
Tricycle, Edinburgh.....*8
Tricycle, electric, Ayrton's.....*367, *420
Tricycle, Merlin.....*334
Tricycle, Strange's.....*137
Trolly, steam, Cooke's.....*63
Trotting statistics. List of trotters that have won races in which the purses, stakes, or premiums aggregated $10,000 and upward.....377
Trout, an easy method of breeding, by J. T. King.....222
Trout and trout culture, by R. A. Koss.....429
Trout, how to propagate. Full instructions for the artificial fertilization of the eggs of the brook trout and for the construction and arrangement of hatching houses.....29
Trout ponds, how to make.....6, *246
Trouve, Gustave, the electrician. Biographical sketch, with portrait.....*362
Truck, car-wheel, forty-two inch.....*82
Truck, elevator, Poirot's.....*331
Truck, freight car, 6-wheeled.....*426
Truss angle-block, Howe, method of calculating the dimensions of, by A. C. Haverstick.....*98
Tube-scraper, Rastrick's.....*93
Tube-stopper, improved, Fenenga's.....*113
Tubercle, infectiveness of, with special reference to tubercular consumption, by Dr. William Pirrie. A valuable paper.....349
Tubercular disease, wheat-meal bread as a means of diminishing, by M. Yates.....363
Tuberoses, how to cultivate.....208, 310
Tubing, seamless.....*279
Tuckahoe, or Indian bread.....*239
Tulles and other light fabrics, machine for dotting, Ricanet's.....*303
Tumors, histology of, by Dr. Carl Seiler....201
Tuning-forks, Koenig's, and the electric register, by Prof. Le R. C. Cooley.....*98
Tunnel, aqueduct, Washington.....*427
Tunnel, Channel, proposed, Raynor's plan..*24
Tunnel, Channel, works at Sangatte.....*35
Tunnel, Hudson River, by S. H. Finch....*331
Tunnel, Hudson River. Detailed account of the great undertaking, with figures showing profile of the river bed, plan of the entire work, several stages of the work in progress, etc.....*227
Tunnel, Hudson River, progress of.....*334
Tunnel, Hudson River; the New York works, progress of, illustrated with figures showing sections of the caisson and tunnel, and details exhibiting the method of working.....*357
Tunnel, Hudson River.....237
Tunnel, Mersey.....384, *427
Tunnel, mining, Atlantic and Pacific.....*359
Tunnel, railway, between France and England. *330
Tunnel, railway, Mersey. General description, with plan and section and view of work in progress.....*292
Tunnel, rock, 7-mile, of Baltimore Waterworks. *135
Tunnel, Severn, mechanical appliances used in the construction of the heading of.....89
Tunnel, Spruce Creek, Pennsylvania R.R...*83
Tunnel, St. Gothard.....*88, 227
Tunnel, St. Gothard. An interesting account of the enterprise, with a description of the interior workings.....311
Tunnel, St. Gothard, by D. K. Clark....11, *12
Tunnel, St. Gothard, by Geo. J. Specht, C.E.154
Tunnel, St. Gothard, completion of the boring. *226
Tunnel, St. Gothard, construction of the gallery, drains, etc.....*26
Tunnel, St. Gothard, historical and statistical notes on, by Consul S. H. M. Byers.....354
Tunnel, St. Gothard, hydraulic machinery...*7
Tunnel, St. Gothard, notes on the junction of the two galleries, by Dr. Colladon.....235
Tunnel, St. Gothard, with 25 engravings of sections showing methods of working.....*225
Tunnel, Sutro. A lecture by Adolph Sutro, giving an interesting description of the manner in which a four-mile tunnel was excavated in the Comstock Lode.....205
Tunnel, Thames, an interesting account of the mode of constructing.....227
Tunnel under the Elbe near Hamburg..*380
Tunnel, Weehawken, with profile, etc....*341
Tunneling machine, hydraulic, Crampton's. *379
Tunnels and arches, beton.....*227
Tunnels and rock boring machinery; method of boring many tunnels described.....*109
Tunnels, railway, principal of the world....201
Tunnels, railway, ventilation of.....11
Tunnels, roads, bridges, and canals, by John Fowler.....353
Tunnels, subaqueous, improved method of constructing, by J. C. Trautwine.....*51
Tunnels, submarine, Bishop's plan for, by Perry F. Nursey.....*20
Turbine wheel, early history of.....414
Turbine wheels, at the Centen.....*59, *61
Turbines, application of to the dynamos of electric railways.....*427
Turbines for small industries, Bell's.....*380
Turkeys, how to manage.....121
Turkeys, how to raise.....40, 227
Turkish bath, what it is and what it does, by John Stainbock Wilson, M.D. Processes of the Turkish bath; its physiological and therapeutic action; what diseases it is a remedy for.....226
Turning, art of. An interesting historical sketch of lathe-working, by P. N. Hasluck..327
Turning, boring, and grooving machines, Atock's.....*23
Turning, ornamental; how to make a candelabrum in wood and ivory, by J. H. Evans..*351
Turning tool for clock makers.....*87
Turpentine, Chian, by Dr. Stiepowich.....288
Turpentine from pine cones, apparatus for distilling.....*216
Tuyere, safety, Lloyd's.....*5
Twilight, how to find the time of.....*421
Twisting machine, new.....*68
Type machine, Hepburn's.....*422

Typhoid fever, (see Fever).
Typhus fever in N. Y., by Dr. E. G. Janeway..298
Typographic machine, Alissoff's.....*95

U

Ulcers, cancerous, chloride of soda in, by Dr. G. M. Rivers.....38
Ulcers, the treatment of with chlorate of potass., by Dr. F. M. Rochester.....162
Ultramarine, quality of, mode of testing..194
Ultramarine violet, processes for the preparation of, Zeltner's.....124
Umbrella-supporter, Arnold's.....*21
Universe, chemical harmony of, by T. Sterry Hunt.....65
Universe, visible, dimensions of, how measured, by Prof. E. Catalan.....*356
Urine, albumen and sugar in, how to test...357
Uranus, discovery of, centenary of, by W. F. Denning.....*303
Urari, how made.....226
Ureometer for clinical use, Blackley's.....*77
Ureometer, Renson's.....*292
Uroscope, pocket-case, new.....*73

V

Vaccination, how long may its efficacy be relied on? by Dr. A. D. Binkerd.....4
Vaccination of animals, by L. Pasteur.....300
Vaccination of sheep.....*337
Vacua, very high, a method of obtaining and measuring with a modified form of Sprengel pump, by Prof. Ogden N. Rood.....*303
Vacuum apparatus, Hemptinne's.....*327
Vacuum, influence of on electricity, by A. M. Worthington.....*382
Vacuum or blast apparatus, laboratory, Hanks'. *7
Vacuum, value of.....276
Valve, ball, improved.....*372
Valve, eccentric, improved.....*99
Valve-gear, novel, Sulzer's.....*146
Valve-gear, rotary, improved.....*267
Valve, safety, Eaves'.....*141
Valve, safety, Fawcett's.....*420
Valve, safety, Klotz's.....*95
Valve, safety, lock-up, Robey's.....*129
Valve, safety, spring, Atock's.....*54
Valve, safety, when not safe.....217
Valve-seats, apparatus to dress.....*281
Valve, slide, explanation of the action of....*51
Valve, slide, how to set. A valuable practical paper.....*13
Valve, sluice, Bagshaw's.....*93
Valve, water and steam, House's.....*99
Valves, hydraulic and slide, for gas and other purposes. A comprehensive and valuable series of papers. *90, *91, *96, *98, *100, *101
Valves, safety, Adams' and Blake's.....*51
Valves, safety, Fletcher's, Schmid's, and Wright's.....*44
Valves, safety, lock-up, Wilson's.....*235
Valves, slide, Taylor-Weatherhogg.....*20
Valves, slide, circular, Webb's.....*96
Valves, slide, plain, friction of, by J. W. Hill. 62
Valves, steam and check, improved.....*138
Vapors, density of, method of ascertaining. 107
Vapors, elasticity and density of, by Alex. Morton.....*86, 87
Vapors, mixed, critical point of, by James Dewar, F.R.S. A record of experiments on the behavior of carbonic acid in the presence of different vapors above the temperature of the critical points of the pure gas.....244
Vapors for medical inhalation, six formulæ.271
Varley, Cromwell Fleetwood, the electrician. Sketch of his life and labors.....405
Varnish, damar, for negatives.....169
Varnish for foundry patterns, recipe.....419
Varnish for melainotypes.....119
Varnish for the preservation of wood and metal, by M. Zingler.....15
Varnish, how to remove from old plates.....93
Varnish, matt, recipe for.....149
Varnishes for foundry patterns, machinery, etc., how to prepare.....153
Varnishes for protecting iron.....226
Varnishes, shellac, recipes for.....185
Vase, marble, Roman.....*98
Vase, Parian.....*157
Vases, terra cotta, at Paris Exhibition.....*147
Vaseline, in pharmacy, by N. Rosenwasser.153
Vault and colonnade in concrete and iron, design for.....*43
Vegetable house, small, advice on the construction of.....66
Vegetable respiration; a correction of some common, yet erroneous ideas concerning the respiration of plants.....230
Vegetables, canned, process of greening...373
Vegetables, how to keep in winter.....304
Vegetation, action of light on.....242
Vegetation, relation of to the industrial arts, by Prof. August Vogel.....332
Vehicle for common roads, Prosser's.....*238
Vehicle, novel, the Swallow.....*388
Vehicles, curious, at the Coachmakers' Exhibition, London.....*187
Vehicles of locomotion, curious.....*380
Velocimeter for trains, Westinghouse's....*64
Velocimeter, light, Wheatstone's.....*165
Velocimeter, projectile, Sebert's.....*177
Velocipede, aquatic, Jobert's.....*8
Velocipede, fast, Grant's.....*8
Velocipede, Harrington's.....*186
Velocipede, improved, English.....*46
Velocipede sled, Story's.....*8
Velocipede, water, Princes of Wales'....*294
Velocipedes and sleighs, propeller for....*159
Velocipedes, or manumotive carriages, improved, Lewis'.....*114
Velocipedes, railway, Sheffield's.....*178
Velocity meter, or self-registering tachometer. Proell's.....*111
Venereal diseases, plan to prevent the spread of, by Dr. Alb. Gibon.....287
Ventilating and warming occupied buildings. *325, *326, *327, *328, *329
Ventilating and warming of school-houses, by Dr. F. Winsor.....98
Ventilating apparatus for large buildings, new.....*87
Ventilating chamber for coal mines, Birnaux's.....*361
Ventilation and obstructed air, vital discoveries in, by W. C. Conant.....388
Ventilation and warming, by D. Galton.....94
Ventilation, blowing engine for.....*142
Ventilation, drainage, and sewerage of houses, by R. Middleton.....272
Ventilation for ships, Boyle's system of..*351
Ventilation, methods of. Report read at the Third Annual Convention of the Am. Public Health Association, by Carl Pfeiffer.....61
Ventilation of Madison Square Theater..*250
Ventilation of mines, mechanical effect of "blown out" shots on, by Hall and Clark....29
Ventilation of public buildings, by James Hogg.....*250
Ventilation of rooms. Abstract of a paper by F. E. Thicke.....66
Ventilation of sewers, Berlin.....198
Ventilation of the St. Louis tunnel, with plan and figures of fan and chimney.....*339
Ventilation, use of coal gas as a means of, by N. H. Humphrys.....391
Ventilator, exhausting, Pelzer's.....*247
Ventilator for mines, Swiss.....*70
Ventilator, Kosmos, Nedden's.....*375
Ventilator, mine, Roots', by E. H. Carbutt. *100
Ventilator, soil-pipe, improved.....*224
Venus, by Camille Flammarion.....*177
Venus, the satellite of, by T. W. Webb.....35
Venus, transit of, 1882, by E. L. Larkin.....348
Venus, transit of, as observed in South Africa and in Cuba.....*378
Vermicelli and macaroni machinery, Metzger's. *170
Vessels, names of, as exhibited in a list of 23,000 belonging to the United States.....262
Vessels, submerged, apparatus for raising.*269
Vessels, sunken, app. for lifting, Archer's.*154
Vessels, sunken, apparatus for raising, Miss Tassey's.....*44
Vessels, sunken, Clark and Standfield's practical method of raising.....*81
Vessels, sunken, method of raising, by Dr. W. Raydt.....280
Vessels to resist high internal pressures, construction of, by C. W. Siemens.....*128
Vesuvius, a visit to, by H. D. Garrison.....175
Vesuvius, the crater of.....*156
Viaduct, Brent, on the Hounslow and Metropolitan Railway, London.....*409
Viaduct, Conway, New Haven and Northampton Railway. General description, with perspective view and several figures of details.*334
Viaduct, Llandulas.....*207
Viaduct, Portage, on N. Y. and Erie R.R...*41
Viaduct, Rouchat, on the Paris and Orleans Railway.....*91
Viaducts, railway, Altier and Cize.....*321
Vibration, influence of on chemical phenomena, apparatus to study, Berthelot's.....*240
Vibrations, inaudible, effect of upon sensitive flames, by W. F. Barrett.....81
Vibrations, mechanical, and magnetism. An account of Mr. Stroh's interesting experiments in comparing mechanical with magnetic phenomena.....*379
Vibrations of a liquid film; a simple device for the projecting of without a lens.....295
Vibrations, sonorous, action of in varying the force of an electric current, by Prof. D. E. Hughes.....*127
Vibrations, sonorous, lantern for exhibiting, Carmichael's.....*254
Vignettes, how to make by means of gelatine chromate.....169
Vinegar, how to clarify and purify.....392
Vinegar, manufacture of by means of bacteria, by Emanuel Wurm. A method of manufacture that gives immediately and without loss a salable article of vinegar of excellent quantity....247
Vinegar, Hengstenberg syst. of making..*396
Vino-colorimeter, for determining the coloring power of wines.....*177
Violin, function of the sound-post in, and on the thickness of the strings, by W. Huggins.*398
Violins, improvements in, Walduck's.....*240
Virchow, Rudolf L. C. Brief sketch of, with portrait.....*95
Virginia, Southwestern, by James Hogg. An important and valuable paper descriptive of the mineral lands, probable richness, geological formations, etc.....366
Viscosity of solutions and apparatus for determining it, by B. T. Trueblood.....*271
Vision, microscopic, Abbe's new theory of, observations on, by J. W. Stephenson.....*81
Vision, persistence of, experiment on.....*284
Visual purple, its nature and offices in the economy of the eye, by W. C. Ayres, M.D...268
Vocal cords, flaying of, as a cure for chronic congestion therein, by Dr. Carlo Labus....265
Volta-electric induction, by W. Smith....*417
Voltaic accumulation. Abstract of a paper by J. W. Swan on the utility of the Plante and Faure cells for the storage of electricity....321
Voltaic arc experiment, a curious.....*227
Voltaic circuit, current elements of, a new method of determining.....*152
Voltmeter, Deprez and Carpentier's.....*353
Volume and surface of bodies generated by revolution, graphical determination of, by W. G. Berg.....*108
Volvox globator, by Alf. W. Bennett....*140
Von Baer, Karl Ernst, the eminent biologist. Sketch of his life and labors.....58
Von Cotta, Bernard. Biographical sketch, with portrait.....*229
Von Monckhoven, Dr. D., biog. sketch of.361
Von Wagner, Johannes Rudolf. Biographical sketch, and an account of his researches in chemistry.....268
Vortex motion, by Prof. O. Reynolds.....85
Vortex rings, liquid, certain phenomena manifested by, by T. Hart.....*400
Vortex rings of liquids and gases, by A. Guebhard.....*301
Voting machine, electric, Roncalli's.....*195
Voting machine, Daville's.....*435

W

Wagner, Richard. Biographical sketch, with portrait.....*379
Walls, brick, incrustations on, by W. Trautwine. 123
Walls, concrete, how to make..183, 285, 418
Walls, hollow, in buildings.....323
Walls, leaning, how to correct.....*399
War manufactures, Woolwich Arsenal....*179
War vessels (see Ships and Steamers).
Warming and ventilating occupied buildings. An elaborate and valuable review of the most approved methods of heating and ventilating dwellings, public buildings, and factories, by A. Morin..*325, *326, *327, *328, *329
Warming by friction, machine for.....*271
Wash-bottle, jet for.....*99
Washers, elastic, for high pressures.....*57
Washers, punch for cutting, Schwab's..*323
Washington Territory, official information concerning its lands, climate, productions, railways, rivers, prices of land, etc.....236
Waste-cleaning machine, improved....*396
Waste, utilization of, by P. L. Simmonds. A highly interesting paper, treating of the uses that are made of vegetable, animal, and mineral waste-products at the present day.....370, 371
Waste water absorber, Ulmann's.....*382
Watch-cases, their uses, materials, and qualities.....333
Watches, demagnetization of....*206, *207
Watches, keyless, by Mr. Grossman.....330
Watchman's detecter, electric.....*315
Water, analysis of, microscopical.....*277
Water and air, a lecture adapted to a juvenile auditory, by John Tyndall.....220
Water and steam joints, how to make, by Joshua Rose. A valuable practical paper.....41, 43
Water bath, constant, simple forms of...*395
Water cock, Sailler's.....*425
Water, cistern, results of analyses of, by Dr. C. R. Stuntz.....277
Water-conduits, apparatus for regulating pressure in, Eichenauer's.....*372
Water-courses, influence of forests on, by D. D. Thompson.....307
Water, drinking, a simple test of quality...147
Water-drops, fine. Abstract of a paper by Prof. Obermeyer on facts that have been ascertained in regard to mist particles.....82
Water-drops floating on the surface of water, by Prof. Osborne Reynolds, F.R.S.....311
Water-gauge, (see Gauge).
Water-glass, preparation, properties, etc..317
Water, hard, how to soften.....270
Water, hardness of, how to determine.....293
Water, how to boil in a paper box.....*247
Water, magnesia-hard, how to soften, by J. Grossmann, Ph.D.....187
Water mains, apparatus for cleaning.....*238
Water, measurement of.....*96
Water-meter, Frazer's.....*259
Water-meter, improved, Huber's.....*1
Water-meter, motor, Hutter's.....297
Water-meter, Richards'.....*16
Water-meter, Schmid's.....*392
Water-meters, Samain's and Deplechin and Mathelen's.....*276
Water-pipe, cast iron, requisite thickness of under heavy pressure, by C. H. M. Blake.....192
Water-pipes, frozen, apparatus to thaw....*1
Water-pipes, useful information concerning friction of.....209
Water, potable, on the detection of lead in by potassium bichromate, by Sidney Harvey...300
Water, potable, organic matter in, actinic method of determining, by Dr. A. R. Leeds.419
Water power, by J. B. Francis.....288
Water power for farms. Description of an ingenious system of farm machinery driven by power derived from a trout-brook.....*323
Water, pure, for photographic use, apparatus for obtaining.....*360
Water, purifying and softening, Porter-Clark process of.....*280
Water railway, novel, St. Malo, France ..*48
Water-softening apparatus, Law and Chatterton's.....*392
Water-softening process, Atkins'.....348
Water, properties of, by W. M. Williams....424
Water supply, by Joseph Prestwich.....143
Water supply for stock, how to arrange..209
Water supply for New York city, increase of, by S. McElvoy, C.E.....53
Water supply for towns and villages; consideration of different systems and their comparative economy of use; cost of boring artesian wells and of water pipes, by Clarence Delafield....27
Water-supply of small towns.....*392
Water-tank controller, electric.....*315
Water, the impurities and influence of upon its domestic utility, by G. S. Johnson....292, 293
Water tower at Sandusky.....*110
Water-traps and soil pipes, by Dr. Fergus..13
Water-traps, new mode of manufacturing, by G. W. Wicks.....*1
Water veins, subterranean, how traced..*269
Water, waste, from fulling mills, how to utilize, by A. Gawalovski.....181
Water, waste, from wool scouring, etc., utilization of, by E. Neumann.....147
Water works, ancient and modern; table of the most important data concerning thirteen waterworks of ancient times, with diagrams....*38
Water works at Bangor, by L. H. Eaton....*77
Water works, Congleton.....*392
Water works, new, at Leamington, Eng...*206
Water works of Phil'a, engines of, by F. Graff..*45
Water works, St. Louis, indicator cards taken at, by A. J. Chaphe.....*123
Waters, inland, of the U. States, areas of...319
Waters, potable, micrographic analysis of..341
Waterproof soles, how to make.....164
Waterproofing cloth, description of several processes for.....58, 317
Waterproofing for paper.....39, 96
Waterproofing for pasteboard.....267
Waterproofing for stone walls, Sylvester's recipe for.....61
Watson, James Craig, the astronomer. An account of his life and labors, by Prof. A. Winchell.....268
Wave lines, description of their true form and how ships should be constructed to meet them, by Dr. J. C. Browne.....*135
Wave motion; the rate of progression of groups of waves and the rate at which energy is transmitted by waves, by Prof. O. Reynolds.....*96
Wave power motor, Brown's.....*46
Waves, curving of round bays and breakwater, by S. R. Deverell.....*109
Wax, an interesting paper by L. Field, descriptive of the qualities, sources, and uses of various waxes of animal and vegetable origin.....*400
Wax, shoemaker's, recipe for.....*169
Waxes, gums, and resins, notes on.....300
Weather, prophecy of, by I. P. Noyes.....249
Weathercock, new, Richards'.....*401
Weathervane, registering, French.....*7
Weavers' reeds, machine for making.....*3
Webb, Capt. Matthew, brief sketch, with portrait.....*401
Wedl, Carl, brief sketch of with portrait..*426
Weeds on the lawn, how to kill.....285
Weighing apparatus, continuous equilibrium, Mangon's.....*349
Weighing machine, automatic, Craig's...*209
Weighing machine, automatic, for grain, Baxter's.....*45
Weights and measures, German system of contraction, new.....137
Weights and measures, International Bureau of. *407, *425
Weirs, fixed and movable; descriptions of the different kinds in use, by L. F. V. Harcourt.220
Welding and its bearing on puddling, by R. Howson.....70
Welding, roll, in the manufacture of steel-edged iron cutters, by L. Hardy.....*9
Welds, steel-iron, how to test.....74
Wells, artesian, (see Artesian Wells).
Wells, driven, Brooklyn system.....*419
Wells, driven, value of for fire purposes....282
Welt and counter-skiving machine, Tripp's. *7
Whales, past and present, and their probable origin, by Prof. Flower.....399
What to do when at a loss. Some brief rules by Dr. S. Weir Mitchell, to be adopted by the physician in cases where a malady has not developed itself sufficiently to form a correct diagnosis of it, but where something must be done at once that shall be beneficial to the patient.....266
Wheat and how it should be prepared.....*234
Wheat and wheat bread, by H. M. Mouries..*275
Wheat farming in California.....*399
Wheat harvesting, new mode of.....198
Wheat, sixty-one bushels per acre, how to obtain.....143
Wheat, microscopic study of, by L. R. Stowell. *159, *172, *178
Wheat, removal of iron from by magnets..*175
Wheat, tests of.....365
Wheel and rail for use on common roads, Hoffmann's.....*377
Wheel, the Ariel.....*55
Wheel-cutting and moulding machine, Scott's. *80
Wheelbarrows, French, at Paris Ex....*165
Wheels, steamboat, the proper proportion of face to diameter.....227
Wheels, truck, road and rail, Perrett's.....*302
Whim, compressed air, Megy's.....*381
Whirling apparatus, Wheatstone's.....*165
Whitworth, Sir Joseph. An interesting account of the life and labors of the inventor of the celebrated Whitworth gun.....248
Whooping cough, antidote for.....264
Whooping cough, croton chloral in.....67
Whooping cough, remedy for.....355
Whooping cough, treatment of, by Wm. Lee, M.D. A valuable paper.....239
Wind force, method of estimating, by John Sutcliffe.....*425
Wind motor, new, the panemone.....*403
Wind motor, the Tourbillon.....*330
Wind, new tables of the velocity and force of, by A. R. Wolff. A valuable and useful paper.. 63
Wind-pressures, instrument for measuring, Howlett's.....*236
Wind, self-registering apparatus to determine direction, velocity, and force of, Draper's.*209
Wind, velocity of, a new method of determining, by John H. Long.....*110
Winding engine, double cylinder, Davey, Paxman and Co.'s.....*19
Winding engine, portable, Swiss.....*64
Winding engines, new method of balancing, by W. Fairley.....*117
Winding gear for mines, Craven's.....*343
Winding machine, doubling Unsworth's.*90
Winding machine, improved, Scott's.....*107
Winding machines, doubling, Boyd's.....*137
Winding machines, Biedermann's.....*265
Windlass and capstan, hydraulic.....*217
Windlass tender for steam plows.....*143
Windmill, as a prime mover, economy of, by Alfred R. Wolff.....335
Windmills, origin of.....*379
Window ornamentation, transparencies for, how to make.....135
Window sashes, how they should be arranged, divided, and glazed.....*147
Windows, drawing-room, designs for.....*342
Windows, proper form, dimensions, etc...263
Winds, direction and velocity of, apparatus for determining.....*7
Winds, gyrating, barometrical high and low pressures caused by, by G. W. Dow.....*99
Wine presses, Primat's, Mabille's, David's, Samain's, Mailhe's, Maupus', etc.....*154
Wines, foreign coloring substances in, a simple test for.....325
Wines, how to test for adulterations in.....278
Winters, memorably cold, a valuable record of. 169
Wire cable gear on steamer Moewe.....*271
Wire cloth, surgical uses, by Dr. Wight....269
Wire, gilt, how made.....378
Wire, gold, how made.....340
Wire, iron, zinc bath for galvanizing.....34
Wire, machine for covering.....*258
Wire rope cable apparatus, Bullivant's....*234
Wire-rope transport; a description of three systems, by W. T. H. Carrington.....*328
Wire ropes, by A. Garcenot.....348
Wires, joining, new method of, Ellis'.....*309
Wood and paper, how to crystallize.....34
Wood, black stains for, recipes for.....125
Wood, dry-rot in, preservative against.....74
Wood, how to dye black.....207
Wood, how to photograph on.....184
Wood, McKenzie's process of diminishing the inflammability of.....89
Wood, new mode of preserving.....153
Wood, on the rational seasoning of, by Sigismund Beer.....272
Wood, preservation of by creosote.....191
Wood, preservation of, by J. C. Jefferson...119
Wood preservative, a natural, by H. H. Nicholson.....308
Wood, process of preserving, Jones'.....334
Wood, process of rendering ductile and flexible, by M. Kobling.....10
Wood-pulp apparatus, Dresel's.....*299
Wood-pulp, manufacture of, including the preparation of cellulose by mechanical and chemical methods.....311
Wood, recipes for staining.....205
Wood, soft, for timber and fuel, experiments in cultivating.....28
Wood, treatment of with ozonized oxygen, apparatus for.....*314
Woodburytypes, how made.....213
Woodbury reliefs.....390
Woods, fragrant, description of many kinds.172
Woods, imitation of inlaid, Spurr and Prang's process.....*10
Woods, some American, shearing strengths of. *242
Wool and yarn, conditioning apparat. for..*327
Wool bleaching, Knab and Fournier meth.135
Wool, bleaching of, without stoving.....89
Wool cleaning machine, Hubner's.....*215
Wool drier, Bolette's.....*161
Wool-drying, apparatus for, Lohren's...*207
Wool dyeing. A series of lectures delivered before the Society of Arts by Geo. Jarmain, giving a thorough and minute description of all the materials, and of the various processes used in dyeing wool.....55, 74, 75, 76
Wool, extraction of grease from. An important technical paper.....261
Wool, how to bleach without sulphur.....149
Wool in the grease, extraction of potash from; apparatus for, Fischer's.....*51
Wool, manufacture of into cloth. An interesting account of the processes of cloth manufacture as practiced in a modern New England mill, by H. G. Kittredge.....321
Wool, mineral, how made.....310
Wool in the skein, new, treatment of.....137
Wool scouring, application of silicate of soda in.....6
Wool, scouring by naphtha.....210
Wool, shrinkage of, how to prevent.....148
Wool, slag, manufacture of.....89
Wool, vegetable, or cosmos fiber.....269
Wool, washing, and its loss in weight.....331
Wool-washing machine, improved.....*392
Woolen cloth, press for.....*146
Woolen fabrics, how to waterproof.....58
Woolen goods, bleaching, process for...*137
Woolen printing, colors for, recipes.....64
Workmen and trades, the improvements that science can effect in the condition of, by Prof. W. E. Ayrton.....211
Worlds, the beginning and ending of, by Camille Flammarion.....186, 188, 200, 201
Worms, the work of, Darwin on, by George J. Romanes.....311
Wounds, arrow, by Dr. H. S. Kilbourne, U.S.A. A valuable paper upon a subject not treated of in surgical works.....295
Wringing and sizing machine for yarn...*360
Writings and paintings, faded, new method of restoring.....134
Wrought iron objects: wood baskets, candle standard, umbrella stand, wine cooler, and music desk.....*295

Y

Yacht, light-draught, fast, stern-wheel, with particulars of contraction, and drawings to a scale showing details.....*179
Yacht Namouna, J. G. Bennett's.....*336
Yacht, steam, cheap (see Boats, cheap).
Yacht, steam, Lady Franklin.....*171
Yacht, steam, light draught stern wheel...*224
Yacht, steam, light draught, Irene.....*172
Yacht, steam, Livadia. Detailed description, with perspective view, and midship and longitudinal sections and hold plan.....*243
Yacht, steam, pleasure, Gitana.....*56
Yacht, steam, Sharpie.....*182
Yacht, steam, small, by M. A. Beck. List of dimensions, accompanied with figures showing plan, elevation and details.....*166
Yacht, steel, fast, Lewins.....*160
Yachts, designs for, by Ed. Jackson.....*78
Yachts, ice (see Ice yachts).
Yachts, small, novel rig for.....*163
Yachts, steam, small; details of construction of two small, swift yachts, with longitudinal and transverse sections and plan to a scale.....*14
Yarn, apparatus for testing the evenness..*170
Yarn, jute, how to bleach.....221
Yarn, machine for flocking.....*137
Yarns, appa. to prevent waste in doubling.*269
Yarns, spot, manufacture of.....*265
Yellow fever, (see Fever).
Yucca, fertilization of, by Thomas Meehan..195

Z

Zinc alloys, explosive.....398
Zinc, apparatus for refining, Merton's.....*371
Zinc bromide, how prepared for photographic use.....144
Zinc, complex ores containing, new process of treating, by E. A. Parnell.....265
Zinc in ores, determination of, by A. Miliot..345
Zinc, its uses and manufacture.....371
Zinc, machine to weigh and classify.....*367
Zinc, manufacture of, by St. P. De Sincay...402
Zinc mines of Lancaster Co., Pa.....89
Zinc mines of Sussex County, N.J., by N. H. Darton.....393
Zinc, phosphide as a nervous tonic.....58
Zinc, pure, how to prepare.....152
Zinc, volumetric estimation of.....336
Zinc, white, direct manufacture of.....51
Zirconia for the oxyhydrogen light, by Prof. J. C. Draper.....93
Zodiacal light, by Prof. C. W. Pritchett.*126
Zodiacal light, the.....241
Zoological station, "flying," Dutch....*408
Zoology, comparative, a lesson in, by Hubbard W. Mitchell, M.D.....367

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Vol. I.	1—26	Vol. X.	235—260
" II	27—52	" XI.	261—286
" III	53—78	" XII.	287—313
" IV.	79—104	" XIII.	314—338
" V.	105—130	" XIV.	339—365
" VI	131—156	" XV.	366—391
" VII.	157—182	" XVI.	392—417
" VIII.	183—208	" XVII	418—443
" IX.	209—234	"XVIII.	444—469

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Notes & Queries

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(1) H. W. G. writes: 1. I have a so-called lightning saw, attached to a small machine. The saw works well in logs not larger than 1 foot 6 inches in diameter; by cutting larger logs, the saw will grind the dust into flour, and do no cutting at all. How would it do to file every third tooth down to a scraper, thus making two double teeth for loosening the dust and one double tooth to scrape it out? A. Probably your saw is too small for logs larger than 18 inches diameter. Every tooth should be capable of taking out its own cut. Sharp, well set teeth, proper feed and power will make the saw cut. 2. Will there be any success in taking letters patent for a corn planter which will plant corn in square hills without squaring off or using the rope or wire so-called check rower? A. The success of your corn planter depends upon its utility and originality and your business application. 3. What is the correct name for the gases known in the German language as sauerstoff, wasserstoff, stickstoff, and kohlenstoff? A. Sauerstoff, oxygen; wasserstoff, hydrogen; stickstoff, nitrogen; kohlenstoff, carbonic acid gas. 4. Do you know of any publication, Treatise on Perpetual Motion, in the German language? A. No, and consider any attempt to attain perpetual motion as effort wasted.

(2) M. S. asks (1) a receipt for making soap that will take grease spots out of cloth. A. Powdered fuller's earth 1 ounce; just moisten with spirits of turpentine, add salt of tartar 1 ounce, best potash 1 ounce, work the whole into a paste with a little soap. 2. A receipt for a paste or composition that will polish gold or silver, something to be put up in tin boxes? A. Equal parts of precipitated subcarbonate of iron and prepared chalk. An impalpable rouge may be prepared by calcinating the oxalate of iron. Take quicksilver with chalk half an ounce, and prepared chalk 2 ounces; mix them. When used, add a small quantity of alcohol and rub with chamois leather.

(3) J. A. G. writes: In using borax with salicylic acid to increase its solubility (equal weights of each), are the antiseptic or disinfecting qualities of the acid changed or diminished? Can you name a better plan? Dissolving in water alone is troublesome, and in alcohol is expensive. A. Borax is of itself an antiseptic, and therefore aids in its degree; alkalies and alkaline salts are said to increase the solubility of salicylic acid. Another method consists in dissolving 10 parts salicylic acid in 24 parts ammonia, and then adding 16 parts dilute acetic acid, or just enough to produce a slightly acid reaction. For bee culture a solution is made by dissolving one ounce of the crystallized salicylic acid in half a pint of French spirits; of this solution add one ounce to pint of soft water at 60° Fah. In cold weather perform this operation in a warm room. This is said to be the method used by all German masters.

(4) N. B. P.—In casting steel and other metals, does it form any longitudinal grain the way it runs, so that it becomes tougher one way than the other? A. No. 2. If combed and pressed in one direction while wholly in a liquid state, will that make it tougher one way than the other? A. No. Cast steel and cast iron are granular, not fibrous.

(5) E. B. asks: 1. What is the difference between a dynamo-electric machine and a magneto machine? A. A dynamo-electric machine furnishes a current which excites its own field magnet. A magneto-electric machine is provided with field magnets formed of permanent magnets, or with magnets excited by a current from another machine. 2. What would be the temperature of a vacuum if no heat was supplied from the outside? A. We do not know by what means the temperature of an absolute vacuum could be determined. The term itself precludes the idea; for to suppose a state of heat or cold implies that something is hot or cold. 3. Would a helix, if formed of steel wire and magnetized, attract soft iron the same as copper wire with electricity flowing through it; and would the attraction be permanent in the steel helix without the use of electricity, that is, if the helix was first magnetized? A. A helix formed of steel wire would act like a copper helix, but not to the same degree. If the steel is hardened, the helix may retain some magnetism, but a spiral form would not give the steel any advantage over magnets of other forms.

(6) W. F. H. writes: Ashes of forest trees here are chiefly carbonate lime. Is this common? Can you supply a few approximate analyses of common forest tree ashes, such as oak, fir, beech, or other? If our ashes are chiefly lime, and no potash to speak of, can we draw any conclusion as to best crop after burning the bush, while land is still too full of stumps to plow? A. The following analyses are taken from Professor Johnson's How Crops Grow, a standard authority on such subjects:

	Oak.	Fir.	Beech.
Potash	10·0	11·8	16·1
Soda	3·6	4·6	3·4
Magnesia	4·8	9·1	10·8
Lime	73·5	50·1	56·4
Phosphoric acid	5·5	5·8	5·3
Sulphuric acid	1·4	2·3	1·0
Silica	1·1	15·0	4·7
Chlorine	0·2	0·4	0·1

In each case you will notice that the lime exceeds in amount the other ingredients. We should therefore infer that your finding so much carbonate of lime perfectly normal. It would hardly be safe to calculate in regard to the crops, unless upon exact information.

(7) M. R. W. asks whether there is such a thing possible as keeping in solution the pulp from which fine paper is made, so that it might at any time be spread with a brush in the manner of paint, and then quickly harden and become paper, and adhesive? Or any chemical that will dissolve paper, and hold it in a liquid form? A. As the mixture of paper fiber and water which forms a paper pulp is entirely mechanical, we know of no way of sustaining the paper fiber in the water, except by means of size, water glass, or some similar substance. Collodion is the nearest approach to a solution of paper that we know of.

(8) W. H. K. asks if a battery can be made powerful enough to feed an incandescent lamp. If so, please tell me which kind of battery would do for that purpose, and how many cells of such a battery it would require. A. A battery may be used for supplying an incandescent lamp, but it is not an economical way of producing a light. 10 or 12 cells of bichromate battery will operate a medium sized incandescent lamp; it will require 15 to 20 cells of Bunsen or Grove battery to do the same thing.

(9) N. W. writes: I claim that at the same number of revolutions per minute a 5 ton fly wheel of 30 feet diameter would be as effectual as a 20 ton fly wheel 15 feet diameter, because the rim of the 30 foot wheel has twice the leverage and twice the velocity of the rim of the 15 feet diameter, and what is true of rim is true of the weight in the arms. Other engineers say I am wrong. What do you say? A. You are about right as far as the momentum is concerned, but there are mechanical reasons inimical to the construction of large light fly wheels for the quick running modern engines, such as deep wheel pit, difficulty of truing, as well as height and floor space. The friction in air would also be greater than the additional friction of the smaller and heavier wheel upon its journals.

(10) P. S. M. asks: What are proper speeds for turning soft wood, hard wood, brass, cast iron, and wrought iron, and what are proper speeds for circular and band saws for ordinary wood sawing? A. The cutting quality of woods and metals is so variable that no empirical rule adapted to forms and qualities can be given. A good rule is to give the work all the speed it will bear without injury to tools. These speeds may be from 500 to 1,000 feet per minute for soft woods, about the same for hard woods, 30 to 60 feet per minute for brass, 10 to 20 feet per minute for cast and wrought iron. Much depends upon the size of the cut. Large cut should be slow, while a small water cut may be run at a high speed.

Speed of saws,	8 inches,	4,000 to 4,500 rev.	per minute.
"	10 "	3,600	" "
"	18 "	2,000	" "
"	24 "	1,500	" "
"	36 "	1,000	" "

Intermediate sizes in proportion. Speed for band saws, 2,000 to 3,000 feet per minute.

(11) J. R. S. writes: We have a Worthington pump 10x10x7, double action suction pipe 4 inches diameter, distance from pump to river 2,000 feet, elevation 16 feet. We cannot find out why it does not work well. I think the distance is too far to fetch the water. My friend thinks not. Please give the cause of failure. A. You do not state enough particulars as to the lay of the pipe, or whether you have a foot valve. The pipe should be laid so that the air will naturally rise toward the pump, with a foot valve at the end of supply—an opening or stand pipe near the pump through which the whole pipe may be filled before starting. If there are siphons in the line that will retain air, they should have openings at their apices, with plugs that can be made air tight. The plugs to be used for filling the suction with water; also have a large air chamber near the pump. With these precautions we think you will have no difficulty. Air in a long suction is very elastic, and cushions in the clearance of the pump.

(12) R. D. G. writes: 1. What is the standard taper for steam and gas pipe thread, taps and dies, and number of threads of different sized pipes? A. Taper of pipe threads, ¾ inch in 1 foot in diameter; ½ inch pipe 27 threads; ¼ inch and ⅜ inch pipe 18 threads; ½ inch and ¾ inch pipe 14 threads; 1 inch, 1¼, 1½, 2 inch pipe 11½ threads; 2½ inch and upward 8 threads. 2. What is the best way to braze small articles ⅛ inch to ¼ inch diameter, outside open forge fire? Can I get heat enough any way from an alcohol lamp? I cannot get gas. A. You may braze small articles with a blow pipe and alcohol lamp, using a large wick, say ½ inch diameter, in a side nozzle like a tea kettle spout. This gives you facility for casting a downward flame upon the work. 3. Can you give me dimensions to go by to make a camera box for making 5 inch by 8 inch pictures, such as the amateur outfits sold by dealers? I can buy a lens, and make my own box if I could get measurements. How can I tell the focal distance by a lens, to place the ground glass screen? A. You require a good achromatic lens or a pair to make an acceptable picture. Get the focal distance by casting an image of the window upon the wall or a card, and measure the focal length. Better get the lens before you make the box.

(13) R. A. R. asks: 1. Does water running through piping produce friction? If so, at what rate? A. It does; the amount of friction is governed by the size of the pipe and rapidity of flow, or height of head. 2. Can water be brought a great distance on the siphon system, say 1¼ miles, with a fall of 20 feet, the water lower where it starts from than some of the intermediate points? Will a 1 inch stream run through an inch and a half piping one mile with a fall of 20 feet, and no intermediate points higher than where it starts from? Suppose, then, water can be conveyed 1¼ miles through piping on the siphon plan, when the fall is 20 feet with intermediate elevated points, about how many gallons of water would run through per day, when the piping at starting point is 2 inches for a quarter of a mile and 1½ inches for a mile? If larger piping is used at either starting point or stopping point, which point is it best to use it at to get the largest flow of water? Or is it as profitable to use 1½ inch altogether, instead of 2 inch a part of the distance? A. If the apex of a local arched siphon is lower than the source of supply, the flow will be forced over it naturally. Or, in other words, if the source of supply is higher than any intermediate ground between it and the delivery, the undulation of the pipe laid over the ground will not materially affect the flow, although the air may have to be discharged at the apices where the undulation is excessive. With 1½ inch pipe the whole distance you will obtain a flow of 8,000 gallons in twenty-four hours. By putting down 2 inch pipe for a quarter of a mile, you will increase the flow about 1,000 gallons per day. We do not recommend two sizes of pipe in the line, but if two sizes are required for special reasons, put the largest at the supply end. In constructing a line over undulating ground that is higher than the supply source, arrangements must be made for starting the siphonage by putting openings with short standpipes at the high points for filling. After filling, the openings must be capped air tight. Cocks or plugs must be used at both ends while filling. Fill at the highest point, or, if you have a force pump, you may fill by pumping in the water at the source of supply, keeping the vents open until they overflow, then cap them.

(14) T. D. writes: A large amount of money is wasted by manufacturers in using a blast for gas. We heat our soldering irons in this way, and have often thought it a wasteful method. Would a row of small holes for small gas jets be cheaper? A. Mixed gas and air, either by concentric nozzles or the Bunsen principle, are now preferred for heating purposes.

(15) A. M. F. asks: What horse power is necessary to get best results to run the screw of a 300 ton boat of 125 feet length? A. The best result does not come especially from the power applied, but depends upon the lines of the boat and the form of the screw. A 75 horse power engine and boiler would probably give you a good working speed of say 7 to 10 miles an hour, according to lines and load. We do not know of the engine you mention, and if we understand your other question, would suggest pure rubber.

(16) T. D. G. asks (1) for the process of tin smelting. A. The metallurgy of tin is given quite fully in the English edition by Crookes and Rohrig of Bruno Kerl's well known "Practical Treatise on Metallurgy." Both the English and Continental processes of smelting are described, and illustrations of the furnaces used are given. 2. Will putting limestone in water used for drinking and cooking extract any of the lime, and make limestone water? A. The limestone if added to water will dissolve to a certain extent, and any free carbonic acid forming in the water will combine with the limestone, forming the bicarbonate.

(17) G. H. J. asks (1) the difference between benzine, naphtha, and gasoline. A. The names mentioned are given to products of the distillation of crude petroleum coming over at different degrees of temperature, and consequently they vary in their specific gravity thus: Gasoline is the lightest mentioned, and has a density of 95° to 80° Baume, naphtha 80° to 65° Baume, and benzine 65° to 60° Baume. 2. Where can I find the process of boring artesian wells described, and the tools used? A. The subject of artesian wells has been very elaborately treated in a series of articles contained in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 156, 157, 158, 159, and 160.

(18) M. C. writes: Please give me a receipt for sticking cork to metal, as cork to the keys of musical instruments. Do you know if a palissandre (rosewood) is liable to crack in our climate? If so, what is good to fill surface cracks, besides shellac? I can use the wax that is in use for express packages for cork to metal, but that will require heat, which I wish to avoid. A. For cement use shellac dissolved in alcohol. The condition of the rosewood must be considered before a definite answer can be given. Well seasoned wood should not crack. Filling composition or fillers can readily be purchased from painters or dealers in their supplies. These consist of whiting, plaster of Paris, pumice stone, and litharge with suitable coloring matter selected to match the wood. French yellow, asphaltum, Vandyke brown, and terra di sienna are the principal substances used for the coloring. After the proper shade has been determined, the selected ingredients are mixed with 1 part japan, 2 of boiled oil, and 3 of turpentine, and ground fine in a mill.

(19) N. Y. K. asks: Will you please tell me of some article that will effectually remove the color from hair? I tried peroxide of hydrogen, but it did not have the desired effect. A. Peroxide of hydrogen is undoubtedly the best bleaching agent that can be used to remove the coloring matter from hair. Gaseous chlorine has been used, but not with such great success as the hydrogen peroxide. In fact, the oxygen is the bleaching agent, and whether it be obtained from the various chlorine compounds or from other substances, its effect must be the same. 2. The best article you know of that will remove hair. A. Electricity is used to remove superfluous hair from the face. Various pastes made from the sulphide of the alkalies and alkaline earths are likewise used. The following is a well known depilatory: Mix 3 parts sodium sulphide crystallized, 10 parts finely powdered quick lime, and 11 parts starch. It should not be applied longer than 2 to 4 minutes.

(20) J. A. writes: Is there any particular rule for the manufacture of triangles? In a portion of this town the ringing of bells on locomotives is so frequent that the ordinary bell alarm on a fire station does not attract the attention of the people, and a triangle is suggested. We want a triangle containing about seven feet long of steel. What width and thickness is best, and is there any particular rule for the make of it? A. For a triangle, take a bar of good tool steel 1 inch square about 7 or 8 feet long. Suspend it by a cord at two points, or lay it upon two pieces of rope upon a bench about one-third of the length from each end. Strike the bar with a mallet and ascertain the axis of vibration by moving the bearings in or out until a full tone is obtained, then mark the bearings and bend the triangle.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

November 18, 1884,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Air compressor, rotary, L. S. Chichester 308,061
Alarm. See Burglar alarm.
Aluminium, extracting the metal, W. Frishmuth 308,152
Ammonia soda, apparatus for the manufacture of, B. D. Maguin 308,093
Anti-friction device, J. M. Weymouth 308,117
Axle box, J. White 308,123
Axle lubricator, car, W. H. Wright 308,128
Balance, proportional, D. L. Roberts 308,190
Barrel header, W. Hoffman 308,072
Beak horn, portable, revolving, E. Mansfield 308,084
Bearings, automatic alarm for friction, J. O'Connell 308,192
Belt fastener, M. Heffernan 308,207
Belt tightener, J. W. Bixby 308,051
Blackboard, W. H. Whittemore 308,296
Blanks, manufacture of split, W. Garrett 308,250
Bolt cutter, C. W. Levalley 308,267
Book, copy, E. P. Conner 308,141
Book, pocket memorandum, H. T. Whipple 308,295
Boot or shoe, F. M. Hoyt 308,074
Boots, machine for making felt, L. Ruel 308,282
Bootle cooler, E. Truxall 308,217
Box. See Paper box.
Brick machine, C. L. Carman 308,309
Buckle fastener, J. F. Button 308,130
Buffer, R. P. Garsed 308,089
Burglar alarm, B. S. Barckdall 308,046
Button, E. F. Bosworth 308,300
Button fastener, J. Lowe 308,269
Button fastener blank, P. H. Sweet, Jr 308,107
Button fastening, J. F. Atwood 308,299
Car coupling, G. O. S. Conway 308,304
Car coupling, W. D. Marshel 308,270
Car coupling, E. F. O'Haver 308,138
Car coupling, W. H. Paugh 308,277
Car coupling, L. & G. P. Stebbins 308,108
Car coupling, A. A. Stetson 308,329
Car coupling, T. Wood 308,229
Car, pilot, J. Pesaña y Piñol 308,315
Car starter, J. J. Anthony 308,232
Carpet stretcher, B. F. Williamson 308,123
Carrier. See Trace or shaft carrier.
Case. See Label case. Violin case.
Cash indicator, register, and recorder, W. L. Horne 308,250
Centrifugal machine, J. C. Poland, Jr 308,326
Chains, art of and machine for making, E. Oury 308,324
Chair, G. C. Winchester 308,226
Chimney cowl, M. Ludwig *et al* 308,317
Churn, A. C. Clark 308,240
Churn, J. H. Taylor 308,215
Churn, B. L. Williams 308,121
Cigarmaker's gauge, H. J. Watteyne 308,115
Clamp. See Thill clamp.
Cleaner. See Coal cleaner.
Clock regulating mechanism, F. A. Lane 308,265
Clover huller, F. Strobel 308,330
Coal cleaner, W. H. Shepherd 308,206
Cock, cylinder, Twigge & Porter 308,353
Coffee roasting, method of and device for, H. S. Jennings 308,169
Coke oven, F. Carves 308,133
Cooler. See Bottle cooler.
Cotton press packing box, J. S. Smith 308,208
Cotton, treating certain kinds of, W. H. Martin 308,185
Coupling. See Car coupling.
Crusher. See Stone crusher.
Cultivator, M. H. Hitchcock 308,071
Cultivator, hand, J. B. Hurd 308,163
Cultivator shield, E. B. Jackson 308,166
Cut-off valve, J. H. Man 308,181
Cutter. See Bolt cutter. Stalk cutter.
Cutting apparatus, W. H. Sharood 308,338
Damper for smoke consuming furnaces, F. Whitehead 308,234
Desk, A. Cutler 308,142
Door hanger, W. Barry 308,125
Doors, stay roller for sliding, E. Laass 308,177
Drawers, Weishampel & Towles 308,221
Drawers, dust cover for, A. J. Hamilton 308,158
Drier. See Fruit drier. Grain drier.
Drier, F. Brotherhood 308,237
Drill. See Grain drill.
Electric cable support or hanger, A. S. Weaver 308,230

Electric circuits, apparatus for breaking, J. L. Huber 308,201
Electric machine, dynamo, S. H. Short 308,207
Elevator. See Hay elevator. Water elevator.
Fabrics, etc., machine for stretching and winding on woven, Lodge & Oldroyd 308,081
Faucet, lock, Howard & Locke 308,161
Faucet, self-closing, T. McHugh 308,186
Feed water heater and clarifier, J. Mahony 308,180
Ferric oxide and sulphurous acid from ferric sulphate, making, T. Terrell 308,289
Filter and cooler, combined, J. Carter 308,056
Firearm, breech-loading, W. S. Teall 308,216
Firearm lock, R. M. De Belleval 308 241
Fire escape, H. T. Linnenbrink 308,179
Fire escape, H. Renesch 308,279
Fire escape, cable, J. J. Oros 308,333
Fire kindler, B. W. Connelly 308,140
Fire kindler, C. Ledue 308,178
Flanging machine, A. Wilbur 308,297
Flooring, etc., manufacturing parquets for, H. Gerike 308,313
Flooring, wood, D. J. Marston 308,184
Fork. See Hay fork.
Frame. See Grindstone frame.
Fruit drier, J. Bachelder 308,047
Fruit jar, N. W. Krouse 308,174
Fruit picker, H. W. Folsom 308,143
Fuel and making the same, artificial, W. Griffith 308,154
Furnace, A. Hopkins 308,073
Gauge. See Cigarmaker's gauge.
Game apparatus, J. A. Fitzgerald 308,147
Gangway for ferryboats, supplemental, C. W. Doten 308,308
Garment supporter, C. H. Yarington 308,220
Gas making machine, W. H. Hutchins 308,314
Gas, manufacturing illuminating, H. M. Paine 308,276
Gate. See Railway gate.
Gate, J. G. Miller 308,274
Generator. See Hot air generator.
Gigging machine, J. Woelfel 308,227
Grain and fertilizers, apparatus for distributing, A. J. Martin 308,271
Grain binder cord holder, C. Colahan 308,062
Grain drier, A. S. Tompkins *et al* 308 291
Grain drill, W. W. & F. M. Mullen 308,090
Grain drill, A. Runstetler 308,327
Grain transferring apparatus, R. S. Richards 308,095
Grinding mill, roller, C. T. Hanna 308,254
Grindstone frame, L. McDermott 308,086
Hame, J. J. Kelly 308,262
Hame strap, D. W. Emmons 308,068
Handcuff, I. Johnson 308,075
Harrow and seeder, combined, J. S. Corbin 308,305
Harvester and husker, corn, E. W. Quincy 308,094
Hat brim edges, machine for trimming, J. Nutt 308,191
Hay elevator, B. Oborn 308,275
Hay fork, horse, P. Werum 308,294
Heat, circulating pipe for the transmission of, B. Röber 308,197
Heater. See Feed water heater.
Heel trimming machine, J. H. Busell 308,056
Holdback, carriage, S. A. Prescott 308,093
Holder. See Ticket holder.
Hook. See Snap hook.
Hoop fastener, W. D. Richardson 308,280
Horse leg brace, H. D. Ward 308 114
Horseshoe, E. R. Marshall 308,085
Hose tube, W. L. Teter 308,331
Hot air generator, G. S. Sperry 308,288
Huller. See Clover huller.
Indicator. See Cash indicator.
Ink and paint mill, L. P. Clawson 308,138
Inkstand, M. Hersberg 308,157
Inkstand, J. S. Ross 308,100
Jar. See Fruit jar.
Label case, druggist's, B. Keith 308,078
Ladder, E. P. Wright 308,334
Lamps, machine for shaving conductors for electric, J. J. Bradley 308,301
Lasting jack, M. O'Fallen 308,091
Lasting tool, H. Brossel 308,058
Leather stretcher, R. S. Jennings 308,171
Leather stretching machine, R. S. Jennings 308,170
Lens, ophthalmoscopic test, C. A. Bucklin 308,302
Lock. See Trunk lock. Vehicle seat lock.
Locomotive, T. P. Chandler, Jr 308,060
Loom shuttle, J. Magee 308,318
Loom stopping mechanism, M. A. Furbush *et al* 308,311
Lubricator. See Axle lubricator.
Lubricator, A. Baur 308,127
Lubricator, Hodges & McCoy 308,258
Maguey mill, E. S. Barreiras 308 049
Mail bag fastener, C. W. Jefferson 308,168
Manure spreading machine, W. H. Crandall 308,064
Mattress frames, construction of spring, E. Hoskins 308,260
Measure, grain, J. W. Moyers 308,322
Measure, tape, F. M. Slagle 308,287
Medical compound, A. Bevier 308,050
Mica sheet, composite, J. L. Borison 308,199
Middlings purifier, C. G. Rollins 308,099
Mill. See Grinding mill. Ink and paint mill. Maguey mill. Roller mill.
Mill burr, L. P. & C. Teed 308,108
Mixing shovel, power, G. D. Whitcomb 308,118
Miter machine, Stilly & Lowery 308,213
Mitering machine, P. Cushin 308,134
Moulding, W. Gardner 308,313
Motion, device for converting, M. P. Buffum 308,129
Motor for light machinery, W. Vogel 308,218
Musical instrument, mechanical, P. Ehrlich 308,249
Nails and spikes, making, H. Greer 308,253
Nose bag, O. C. Hayward 308,256
Nut lock, S. A. Lesan 308,266
Oil meal, process of and apparatus for cooking, J. H. Valle 308,113
Package, liquid containing, J. M. Stimpson 308,105
Packing, cupped leather piston, A. Campbell 308,239
Packing, piston, W. Heston 308,158
Paint for ships bottoms, drydocks, etc., composition, J. H. Dilks 308,066
Painter's sizing, fresco, H. De Roast 308,143
Painting on glass, decorative, E. J. Irlando 308,164
Paper box, E. B. Munson 308,190
Paper feeding device, A. Sedgwick 308,285
Paper feeding machine, G. White 308,119
Paper folding machine, J. H. Stonemetz 308,214
Pawl, G. Roberts 308,097
Peg wood sharpener, W. G. Scott 308,204
Pegging machine, H. Schürhuber 308,203
Pen, stylographic, L. E. Dunlap 308,144
Piano action, J. Radolf 308,201
Picker. See Fruit picker.
Pipe casing, J. F. & J. F. Wood 308,226
Plane, rabbet, J. A. Traut 308,332
Planter, check row, corn, J. Kirkwood 308,173
Planter check row, corn, J. D. Smith 308,326
Plow, M. Satterlee 308,283
Plow jointer, O. W. Haegg 308,255
Plow standard, J. R. Sampson 308,207
Post driver, F. M. Ewers 308,310
Poultice, A. Elberson 308,248
Press. See Printing press.
Press for dishing hollow articles, J. Robertson 308,098
Printing press, T. Forknall 308,150
Propelling vessels, L. C. Thorp 308,109
Protector. See Vine and fruit tree protector.
Pulp in pulp engines, stirring, G. F. Harlan 308,255
Railway chair, Bryant & Hopkins 308,054
Railway, elevated, T. P. Chandler, Jr 308,059
Railway gate, automatic, H. C. Reynolds 308,193
Railway signaling apparatus, electric, B. Kronbiegel-Collenbusch 308,316
Railway switch, dynamo-electric, M. Marshall 308,269
Railway switch lock, P. L. Pettengill 308,278
Railway track clearer and flanger, M. Ellis 308,067
Rattan scraping and splitting machine, Clinton & Agroff 308,139
Refrigerator, D. H. Spicer 308,102
Refrigerator wagon, J. A. Frey 308,151
Revolver, J. M. Marlin 308,183
Revolver, double-acting, J. T. Aldrich 308,231
Revolving table, W. L. Fleming 308,245
Roller. See Shade roller.
Roller mill, O. A. Byrns 308,128
Ropes or cords, device for attaching loops to, A. McDonald 308,097
Rotary engine, P. B. A. Ganot 308,249
Rubber compositions, manufacture of, J. J. C. Smith 308,209
Rubber, devulcanizing and restoring vulcanized, J. J. Montgomery 308,180
Sails, reefing, T. Fearon 308,146
Sash fastener, I. N. Buck 308,055
Sawmill feed mechanism, J. Cook 308,063
Saw teeth, device for setting and jointing, D. Logan 308,082
Sawing machine, band, P. Miller 308,188
Scale, W. R. Morse 308,321
Scale, E. R. Puffer 308,195
Screw, J. Frearson 308,246
Screwdriver, J. Frearson 308,247
Sewing machine covers, hinge plate for, W. Klenha 308,264
Sewing machine shuttles, bobbin for, W. Koch 308,078
Sewing machine tuck folder, W. Matthews 308,319
Shade roller, J. Allen 308,124
Sharpening machine knives, device for, R. O. Owen 308,092
Shawl strap, T. Brooke 308,054
Sheet metal vessels, collar for, J. F. Ross 308,281
Ship's drag, F. Stanke 308,211
Shirt, S. A. Fishel 308,244
Shovel. See Mining shovel.
Shutter fastener, I. Brooke 308,128
Shutter worker, H. Camus 308,057
Shutter worker, M. E. Peterson 308,194
Skate, roller, F. B. Mueller 308,089
Skid, freight car, J. L. Rowe 308,200
Smelting nickel and cobalt ores, A. Krupp 308,175
Snap hook, G. A. Washburn 308,219
Soap, pyrethrum, J. Zacherl, Jr 308,172
Spikes and machine therefor, manufacture of, H. Greer 308,251
Spikes, die for and method of making, H. Greer 308,252
Spindle bolster, G. Jaquith 308,167
Square, try, W. B. Edwards 308,145
Stalk cutter, G. W. & G. A. Davis 308,306
Stamp, hand, J. P. Ellacott 308,309
Steamer, J. G. Webb 308,116
Stone, art or process of and composition for making artificial, J. H. Trickey 308,111
Stone crusher, T. A. Blake ..... 308,234 to 308,236
Stone, treating natural and artificial, J. L. Kessler 308,263
Stool, piano, H. W. Hadley 308,155
Stopper in washbowls, sinks, and bathtubs, M. F. Deegan 308,307
Stove and furnace grate, T. Kruse 308,176
Stove, heating, A. J. Weiss 308 222
Stovepipe thimble, A. J. Martin 308,272
Stove, steam generating, B. E. Sperry 308,210
Stoves and grates, construction of domestic, H. Thompson 308,290
Strap. See Hame strap. Shawl strap.
Straw stacking machine, C. E. Merrifield 308,088
Sucker rod, R. H. Black 308,238
Supporter. See Garment supporter.
Syringe attachment, C. H. Rutlin 308,238
Table. See Revolving table.
Tapping gas and water fittings, machine for, E. J. Manville 308,182
Telephone, J. N. McIntire 308,273
Telephone and time system, combined, R. W. Willson 308,225
Telephone exchange system, J. P. Freeman 308,248
Telephone exchanges, multiple switchboard for, M. G. Kellogg 308,315
Telephone system, C. A. Jackson 308,165
Telephonic instrument support, Tregurtha & Loring 308,110
Tetrahydro-parachinanisol, production of, Z. H. Skraup 308,286
Thermostat, A. W. Tubbs 308,293
Thermostat, Wilder & Clark 308,120
Thill clamp, H. K. Forbis 308,149
Thrasher and separator, combined, J. Davis 308,065
Thrashing machine cylinder teeth, blank for forming, J. Christian 308,135
Thrashing tooth, J. Christian 308,136
Ticket holder, J. H. Stewart 308,105
Tobacco granulating machine, M. Shirk 308,101
Tongue support, J. W. Schwarzel 308,284
Trace or shaft carrier, M. B. Carey 308,132
Track crossing apparatus, H. Aiken 308,298
Trees, device for felling, P. Miller 308,187
Trunk lock, E. T. Starr 308,212
Tube. See Hose tube.
Valve gear, A. B. Landis 308,079
Vehicle seat, J. Walton 308,113
Vehicle seat lock, A. E. Steel 308,104
Vehicle, two-wheeled, L. S. Clark 308,137
Vehicle, two-wheeled, J. Howell 308,162
Vehicle wheel, C. E. Tower 308,292
Vessel and apparatus for cutting channels in waterways, J. Gates 308,153
Vessel for dispensing fluids, P. Hartmann 308,070
Vine and fruit tree protector, E. D. Hill 308,159
Violin case, H. Kleineick 308,077
Warming pan, J. Barton 308,126
Watch mainspring winder, A. F. Robbins 308,096
Watch spring holder, C. H. Morgan *et al* 308,320
Water elevator, Lobb & Strader 308,080
Wheel, J. I. Hoke 308,160
Windmill, C. S. Sellers 308,205

TRADE MARKS.

Biscuits, J. Beatty & Co 11,676
Biscuits, Johnston Bros 11,684
Blankets, W. Ayres & Sons 11,675
Carpet warp, Mount Ida Manufacturing Company 11,686
Cigars, Fitzpatrick & Draper 11,680
Cough and croup sirup, N. K. Mansfield 11,685
Cough sirup, J. M. Sparks 11,692
Crackers, milk, G. Young 11,697
Flour, wheat, P. H. Copland 11,678
Hame tugs, Underwood Hame Tug Company 11,693
Inhaling vapors and compounds for use therewith, apparatus for, C. B. Harness 11,677
Liver compound, D. W. Curry 11,679
Medical compound for the cure of skin diseases and purification of the blood, J. F. Pool 11,689
Medicines, certain specified, Hop Pill Manufacturing Company 11,683
Medicine for purifying the blood, patent, R. J. Smith 11,691
Panniers or bustles, Alaska Down Company 11,672
Poisonous compound for destroying animals and insects, Weeks & Potter 11,695
Remedies for rheumatism, A. H. Warner 11,694
Ribbons, velvet, Giron Freres 11,682
Sirop mineral sulfureux, F. Renard 11,690
Steam boilers, Rice, Whitacre & Co 11,696
Tobacco, plug, Pfingst, Doerhoefer & Co 11,688
Tobacco, plug chewing, R. A. Patterson & Co 11,687
Tobacco, smoking and chewing, C. W. Allen 11,673, 11,674
Yeast, compressed, Fleischmann & Co 11,681

DESIGNS.

Air compressor frame, C. Beseler 15,551
Carpet, H. Horan 15,553, 15,554
Carpet, C. W. Swapp 15,558
Clock case, A. O. Jennings 15,558
Clock case, S. B. Jerome 15,559
Coffin handle, T. S. Powers 15,562, 15,563
Costume, lady's, M. Kavanagh 15,561
Costume, lady's, J. Q. Reed 15,564
Costume, lady's, S. J. Shiels 15,565
Costume, miss's, M. Kavanagh 15,560
Drip pan, C. Woehrle 15,570
Handkerchief, H. B. Wilson 15,569
Hatchet, W. S. Skinner 15,567
Lamp globe, J. J. Kittel 15,566
Pipe mouthpiece, M. Dittenhoefer 15,552
Type ornaments, H. Ihlenburg 15,555
Type, printing, H. Ihlenburg 15,556, 15,557

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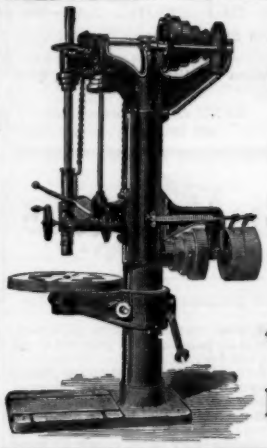

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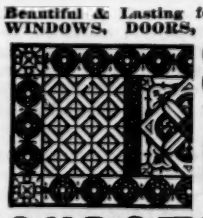

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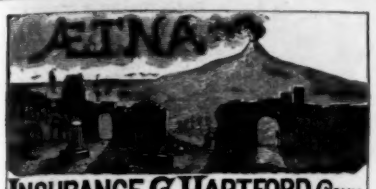

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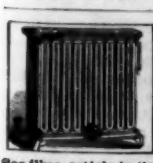

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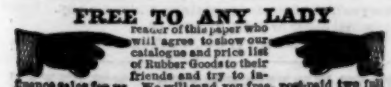

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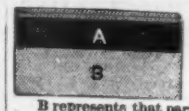

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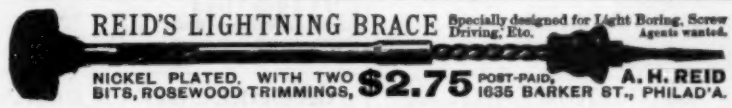

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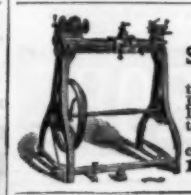

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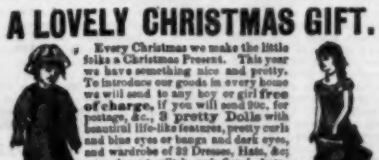

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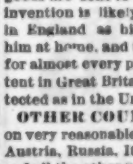

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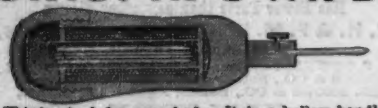

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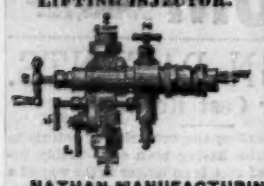

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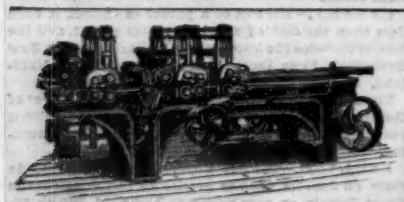

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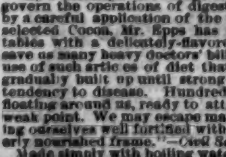

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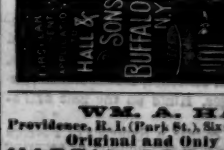

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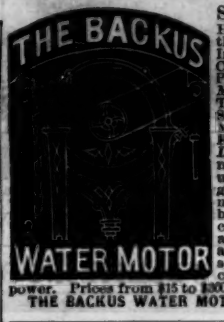

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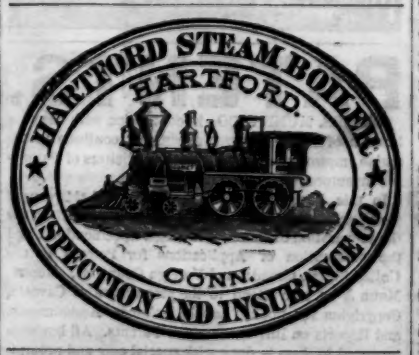

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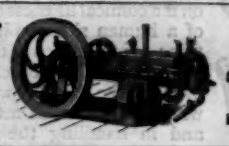

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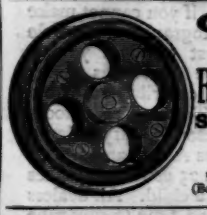

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